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NOTES ET ACTUALITES

Personalia

M. P.O. Wiehe*, phyto-pathologiste au département de l'Agriculture, a quitté la colonie au début de janvier pour le Nyasaland où il a obtenu une promotion bien méritée. Les vœux de succès de ses collègues et nombreux amis l'accompagnent.

Nous apprenons avec plaisir que M. A. de Sornay a été titularisé aux fonctions de généticien de la Station de Recherches sur la canne à sucre. Nous félicitons également M. G. Orian qui succède à M. P.O. Wiehe comme phyto-pathologiste et dont la nomination couronne une carrière déjà riche de recherches dans le domaine phyto-sanitaire.

M. Henri d'Unienville, après de longues années comme administrateur de Mon Loisir Lagesse, a pris sa retraite à la fin de décembre. M. N. J. Harel lui succède.

M. N. Craig, directeur-adjoint du Service de l'Agriculture, est parti en congé pour l'Angleterre au début de février. Nous lui offrons nos vœux de bon voyage et d'heureux séjour dans la terre natale.

L'amélioration des races d'animaux domestiques

L'amélioration progressive des races d'animaux domestiques constitue pour l'homme un problème du plus haut intérêt. Dans un ouvrage † intitulé " Animal Breeding ", L. M. Winters fait le point de nos connaissances actuelles à ce sujet. L'ouvrage, qui est à sa 4e édition, a remporté un succès mérité dans les milieux scientifiques et agricoles. Dans cette quatrième édition le cadre général a été conservé, mais une place particulièrement importante a été faite à la sélection et à des questions à l'ordre du jour telles que l'insémination artificielle. L'application des lois de Mendel à la détermination de conditions rationnelles de l'élevage fait l'objet d'un chapitre spécial. Les chapitres suivants exposent d'une façon précise les modalités des différentes méthodes de sélection, avec leurs avantages et leurs inconvénients respectifs, les procédés modernes d'élevage, d'insémination, etc. Ce livre sera lu avec beaucoup d'intérêt par les agriculteurs, éleveurs, vétérinaires, etc.

(Chimie et Industrie — Octobre 1948)

* Voir Revue Agricole — Mai-Juin, 1948, p. 94.

† Publié par John Wiley and Sons, 1948.

Nouvelles méthodes de conservation des denrées périssables

Dans un article publié dans le numéro de juillet-septembre 1948 des Industries Agricoles et Alimentaires G. Jakovliv examine successivement les méthodes modernes de conservation des denrées périssables. La *pasteurisation ultra-rapide* des aliments liquides connaît un développement grandissant. On applique une température supérieure à 90°C pendant un temps très court, ce qui évite la caramélisation et le goût de cuit. Ce mode de conservation a été appliqué aux jus de fruits, au lait, à la crême, aux jus pectiques, etc.

La stérilisation par le chauffage *diélectrique* au moyen d'un champ d'alternance très rapide appelée encore la stérilisation *électronique* reste jusqu'ici du domaine du laboratoire.

L'irradiation ultrasonique fait subir aux cellules une intense agitation tourbillonnaire et au proloplasme des remaniements mystérieux. On est parvenu à stériliser ainsi complètement le lait par les vibrations soniques de l'ordre d'un ou deux microns d'amplitude.

L'irradiation ultra-violette n'est employée pratiquement que dans les abattoirs.

La conservation des aliments par l'élimination quasi totale ou partielle de leur humidité accuse des innovations dont certaines sont pleines d'intérêt. La déshydratation des viandes débitées en cubes de 5 cm. a été réalisée en Amérique. Les concentrés de fruits peuvent être définitivement stabilisés en pâte sèche, en granulés ou en poudre. Le lait complet en poudre peut se garder intact durant 8 mois à la température ambiante. La déshydratation d'aliments liquides par la *cryoconcentration*, c'est-à-dire par la congélation lente et l'extraction de la glace formée broyée par centrifugation, connaît des applications déjà très anciennes dans le domaine des jus de fruits. R. Gane, de l'Université de Cambridge, préconise la concentration de la bière. Il obtient un produit ayant jusque 18% d'alcool sans perte de goût et de saveur.

La déshydratation d'aliments par la lumière infra-rouge est appelée à un développement certain. On envisage la dessication artificielle de fourrages en lieu et place du séchage naturel. L'irradiation infra-rouge présente un intérêt particulier pour la dessication des fruits et des légumes. Parmi d'autres applications connues ou possibles, citons le séchage des feuilles de tabac, des pâtes alimentaires, la concentration de jus de fruits et de sirops divers, le grillage du pain, la cuisson des biscuits et le séchage des œufs, des viandes et des poissons.

La déshydratation a de sérieux inconvénients : perte de saveur et de valeur nutritive, mauvaise réhydratation et conservation imparfaite à la

température ambiante. D'autre part, l'inconvénient des aliments conservés par congélation rapide réside dans la nécessité d'usiner, de stocker et de transporter de grands poids et volume.

Une méthode mixte, la *déshydrocongélation*, supprimant totalement les inconvénients de deux procédés précités, vient de naître. Elle consiste à priver les aliments frais de la moitié de leur humidité. De tels aliments décongelés se réhydratent d'une manière parfaite et sont comparables en tous points aux produits congelés.

A l'heure actuelle, la congélation rapide est certainement la méthode la plus parfaite de conservation des denrées périssables. Les produits surgelés supportent aisément la comparaison avec la plupart des aliments frais à l'état tel qu'ils sont habituellement consommés.

L'auteur conclut en ces termes : " L'âge atomique nous apportera-t-il un moyen de destruction aisée des microorganismes et des diastases et de ceux-là seulement ? D'ores et déjà, une révolution semble se préparer dans les méthodes de conservation d'aliments périssables au point d'en écarter l'emploi du froid ou de la chaleur, par les découvertes du Dr. A. Brasch et de ses collaborateurs américains. Ces savants sont parvenus à construire un désintégrateur atomique capable de produire un intense rayonnement d'électrons dont la période est moins d'un millionième de seconde. Ces oscillations rapides émises par leur " capacitron " ont un effet spécifique sur la matière vivante ou morte. Les électrons arrêtent mystérieusement presque toutes les réactions biochimiques sans endommager sérieusement la structure tissulaire.

" On a constaté que la viande crue, les fruits et les légumes frais soumis à cette irradiation peuvent être conservés pendant des mois et peut-être indéfiniment, sans concours de la chaleur ou du froid profond. Un tel bombardement d'électrons détruit les microorganismes et, sans doute, les diastases. Les effets du capacitron peuvent être réglés en variant l'intensité du rayonnement. Effectivement, ces auteurs ont pu constater qu'un rayonnement faible détruit la capacité de reproduction des microorganismes, sans les tuer. En outre, un rayonnement suffisant accuse son plus grand effet en profondeur de la matière bombardée. Il existe l'espérance de pouvoir utiliser cette énergie au traitement des cancers profonds, sans dommage pour les tissus sains."

Utilisation des explosifs en Agriculture

Une étude fort bien documentée parue dans " Fruits d'Outre-Mer "— Vol. 2, No. 8, 1947, sous la signature de H. Guyot, Ingénieur de l'Institut Agricole de Nancy, Agronome de l'I.F.A.C., et portant le titre ci-dessus

contient de précieux enseignements dont certains sont applicables à Maurice. Nous ne retiendrons que ceux ayant trait au dessouchement des arbres et à la trouaison pour la plantation d'arbres fruitiers. On pourrait, en effet, employer l'explosif pour le dessouchement des filaos exploités régulièrement sur les pas géométriques de l'île et pour la création de vergers dont le pays a un si grand besoin.

Le dessouchement des filaos demande un effort manuel considérable et au prix de la main-d'œuvre actuelle des dépenses excessives. La destruction des souches variera suivant :

1o La nature des racines (grosseur, hauteur, état, etc.)

2o Les propriétés du sol.

3o L'état de conservation de la souche.

Elle peut être réussie par n'importe quel opérateur. La manière dont on dispose l'explosif influe considérablement sur l'efficacité du travail réalisé. L'explosif se place, en général, sous la souche, en une ou plusieurs charges.

Lorsque les arbres ont une racine pivotante, comme le filao, il y a deux façons d'extraire la souche :

1o En plaçant la charge entière, dans un seul trou, au milieu de la racine.

2o En répartissant deux ou trois charges dans des trous situés latéralement par rapport à la racine.

Comme la plupart des filaos à dessoucher sont de diamètre assez faible le premier procédé pourra être employé de préférence au second qui exige l'allumage par un courant électrique. On creuse un trou oblique après avoir mis à nu, au moyen d'une bêche à fer étroit, le pivot de la racine, jusqu'à une profondeur de 25 à 30 cm. au-dessous du niveau du sol. Ou bien on creuse un trou oblique pénétrant dans le bois, à l'aide d'une tarière à bois, d'un diamètre suffisant, de manière à placer la charge aussi profondément que possible à l'intérieur du pivot et au point de résistance. On comprime fortement la charge dans le trou, on place la cartouche, on amorce et on bourre très fort jusqu'au bout.

La charge à employer pour le dessouchement est généralement calculée en fonction du diamètre de la souche. La charge optimum à employer est déterminée par l'expérience acquise dans quelques essais préalables. Il est préférable d'utiliser un poids d'explosif un peu trop élevé. Ce poids se calcule d'après de nombreuses méthodes. Nous ne retiendrons ici que la méthode anglaise. On fait le carré de la circonférence de la souche, on le multiplie par 10, on divise ensuite le résultat obtenu par 3, si les arbres n'ont pas beaucoup de racines, et par 2, s'ils en sont bien pourvus. Le quotient obtenu exprime le nombre d'onces de dynamite à 25 o/o nécessaires (1 once = 28 gr. 35).

Voici un tableau établi d'après cette méthode et où la charge est exprimée en grammes.

Circonférence des souches	Diamètre	Charges d'explosifs nécessaires		
		Arbres peu enracinés	Arbres bien enracinés	fort enracinement
0 m 94	0 m 40	83 gr	125 gr	250 gr
1 m 25	0 m 40	150	225	450
1 m 57	0 m 50	235	350	700
1 m 88	0 m 60	335	500	1,000

Aux Etats-Unis, beaucoup plus qu'ailleurs, les arboriculteurs et pépiniéristes emploient couramment les explosifs dans leurs plantations d'arbres fruitiers. Ils ne plantent qu'en terrain miné et améliorent de la même façon leurs vieux vergers.

Les avantages que l'on retire de ce travail par explosif sont :

1o. L'ameublissement du sol est fait jusqu'à une profondeur de 1m 50 à 2m et plus.

2o. Il donne au sous-sol une capacité d'absorption d'eau qui met ainsi les plantations à l'abri de la sécheresse. Il en résulte ainsi au moment de la plantation une reprise plus certaine des jeunes plants.

3o. Il crée un drainage naturel du sol (empêche la stagnation des eaux de surface).

4o. Enfin, et ceci est des plus intéressant, il facilite le développement des racines, et, de ce fait, accélère la croissance de l'arbre et la fructification se fait plus tôt.

Il ne s'agit pas de remplacer le creusement des trous à la pioche, mais le rôle de l'explosif est de faciliter cette tache, par l'ameublissement du sous-sol et de favoriser le développement des racines dans l'avenir.

Le minage en vue de la plantation doit se faire, dans les pays tropicaux, pendant la période sèche, par exemple, à Maurice, de septembre à décembre.

Sur un terrain nu, après avoir marqué l'emplacement des arbres, on fore un trou en chacun des endroits retenus avec la barre à mine ou une barre pointue, ou à l'aide de la tarière rubanée. La profondeur des trous varie suivant la nature du sous-sol ; elle variera généralement de 0 m 60 à 0 m 90. La charge variera entre 200 et 400 gr., le bourrage doit être fait serré.

Si la charge et la profondeur sont convenables, il ne doit presque pas y avoir d'effet de surface, le sol étant légèrement soulevé et fendu. Une cavité, qu'il faudra combler, se formera à l'endroit de la charge. Après l'explosion, il faut, si rien ne presse, laisser pendant quelques jours le

trou sans y toucher, pour donner au sol le temps de bien s'aérer. On prépare ensuite le trou de plantation.

L'Ammoniaque deviendra-t-elle l'engrais liquide de l'avenir ?

L'agriculture mondiale souffre d'une dangereuse insuffisance d'engrais azotés. Une des raisons de cette insuffisance réside dans l'énorme besoin d'énergie que nécessite la fabrication de ces engrais. En utilisant l'ammoniaque comme engrais liquide on économiserait beaucoup d'énergie. Depuis la guerre de 1914-18, l'industrie des engrais azotés utilise de plus en plus un procédé de synthèse qui, en partant de l'azote de l'air, aboutit à l'ammoniaque. L'ammoniaque est ensuite transformée en nitrate d'ammonium ou en nitrate de soude. Cette transformation demande une grosse dépense d'énergie et coûte cher.

Depuis assez longtemps on a envisagé l'emploi de l'ammoniaque en solution dans l'eau comme engrais. Les Américains en ont tenté l'utilisation dès 1943 et ont trouvé que sous cette forme le kilogramme d'azote revenait trois fois moins cher que sous la forme nitrate de soude.

On pouvait craindre que l'ammoniaque fut lavée rapidement par les pluies mais on sait qu'elle se combine avec l'argile du sol et se décompose par la suite assez lentement. La plupart des plantes utilisent avec profit l'ammoniaque liquide. Des essais furent faits sur de très grandes surfaces aux U.S.A. entre 1943 et 1946. Pour le maïs et l'avoine les récoltes traitées à l'ammoniaque donnèrent des rendements beaucoup supérieurs à celles traitées au nitrate d'ammonium.

Deux méthodes donnèrent des résultats remarquables : application d'engrais liquides juste avant les semailles : distribution dans les rangs entre les jeunes plantes.

L'azote sous forme ammoniacale est bien meilleur marché que sous forme de nitrate solide. Mais en revanche, son emploi pose certains problèmes dus, avant tout, à sa forme d'engrais liquide. Les tracteurs doivent être munis d'un équipement spécial. Cet équipement comprend un réservoir métallique d'où le liquide est conduit vers le sol par des tuyaux flexibles munis d'un bout en fer, pénétrant à 4 cm. environ de profondeur dans le sol. La tranchée ainsi ouverte est recouverte de terre par des disques ou des houes placés juste en arrière des tuyaux. Un tel équipement coûte assez cher. Mais, dans l'ensemble, les fermiers des Etats de Louisiane et du Missouri, jugèrent que la dépense était rentable. Afin d'éviter aux tracteurs de trop fréquents voyages jusqu'à la ferme, des citernes remplies d'ammoniaque liquide sont amenées sur le champ même.

(Libération Paysanne — 4 Nov. 1948).

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Have the pleasure to announce the visit to Mauritius of Mr. van Graan, a highly-trained demonstrator, specially selected by our Principals, African Oxygen & Acetylene (Pty) Ltd., Johannesburg, for his wide knowledge of the application of the oxy-acetylene welding and cutting process, the electric arc-welding process, the flame descaling process, the metallization (metal spaying) process, and various kindred processes.

Mr. van Graan, who arrived here by s. s. " BANAN " on February 8, 1949, hopes to spend two or three months in the Colony, during which time his mission will be to demonstrate the most efficient practical and economic methods of employing the various processes enumerated above, and to run tuitional courses of instruction for clients' artisans who operate clients' equipment. These services will, of course, be absolutely free of charge.

Agriculturalists, industrialists, workshop proprietors and all others interested are invited to contact us in person at the above address, or by telephone or letter, or through our Mr E. C. Davidsen who periodically visits most sugar estates in the island, to obtain further particulars or to arrange appointments for Mr. van Graan to visit them.

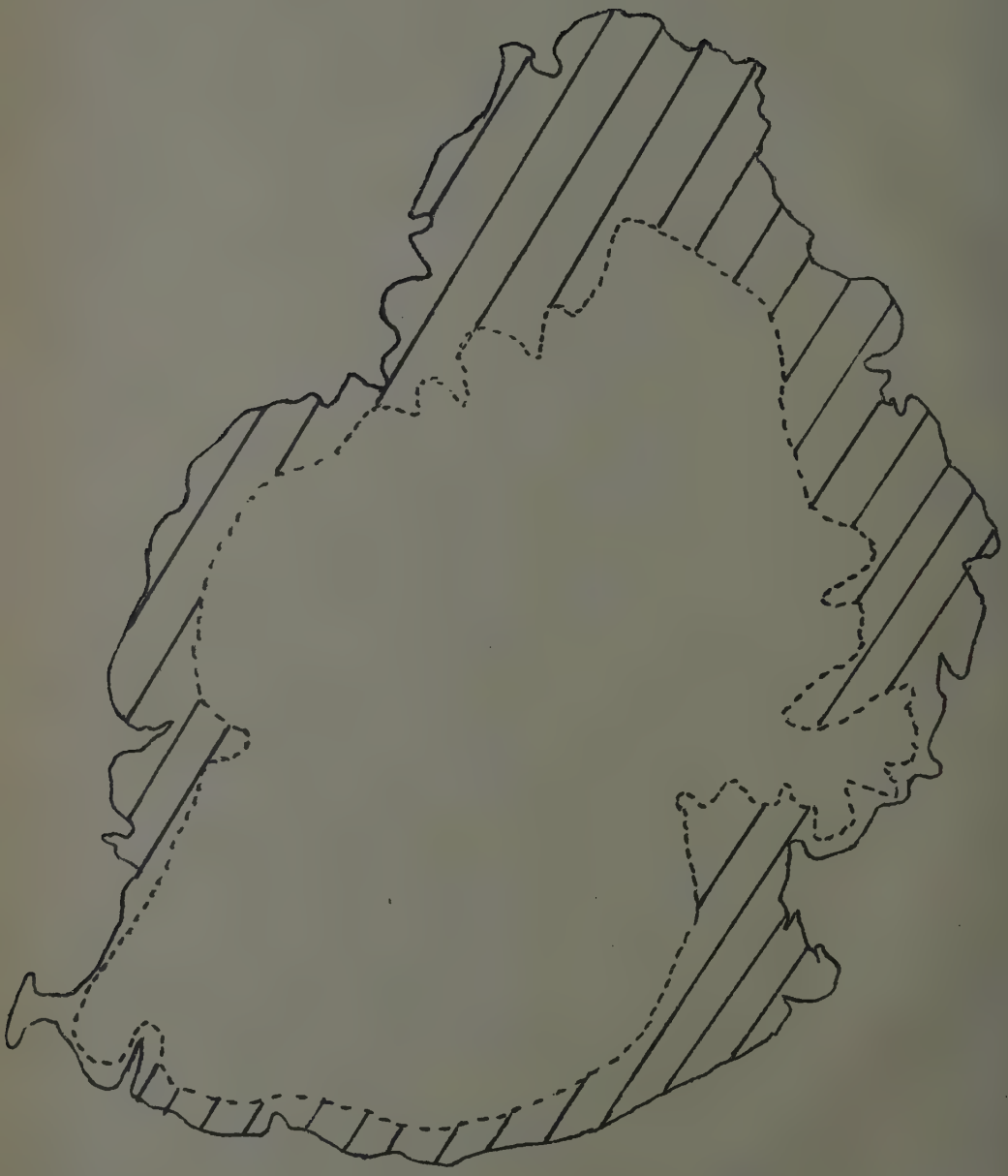


Fig. 1 Map of Mauritius showing the 300′ contour (dotted line). The distribution of smut corresponds approximately to regions below that level (shaded).

RESULTS OF SOME EXPERIMENTS ON SMUT OF SUGARCANE IN MAURITIUS

P. O. WIEHE

Formerly Plant Pathologist, Department of Agriculture, Mauritius.

1) *Introduction*

Smut of sugar cane caused by the fungus *Ustilago scitaminea* (Rab.) Lyd. may be considered as one of the major cane diseases occurring in Mauritius. Its importance is overshadowed at the present day because the chief variety under commercial planting, M : 134/32, is highly resistant or immune to the disease. Smut, however, has been responsible for significant damage to the cane crop in the past and has been a contributing factor in the decline in cultivation of such suceptible varieties as BH 10/12 and DK/74. The disease remains also a potential danger and precludes the cultivation in certain regions of otherwise popular varieties, such as M 171/30.

Smut reaches epidemic proportions only in lowland localities of the island and the districts which have suffered most in the past are Pamplemousses. Rivière du Rempart, Black River and parts of Grand Port and Flacq. The 300' contour which is shown in fig. 1 corresponds approximately to the distribution of smut in the island.

The results of experimental work described in these notes were obtained in 1939-1941, when some attention was devoted to this disease in view of the suceptibility of the variety BH 10/12 then grown on a large scale.

2) *Seasonal Appearance of Smut*

With a view to determine the seasonal variation in the appearance of the disease the following trial was laid out at Pamplemousses Experimental Station. Fourteen holes of each of the three varieties DK/74, BH 10/12 and White Tanna were planted in October 1938. In February 1939, when the plants were well established, the roots were wounded and smutted cane shoots were disintegrated and mixed with the soil around each stool. This method of inoculation was satisfactory and showed that infection may take place through the roots and underground shoot system of the

cane plant. The following number of stools showed symptoms of smut during the period March-August :

DK/74	9
BH 10/12	10
White Tanna	13

The canes were cut in October and monthly observations were thereafter made on the number of diseased stools and the number of smutted shoots produced by each stool. The smutted shoots were cut and destroyed after each observation. The results obtained are summarised in Table 1 and fig. 2. Climatic data for the same period are given in Table 2.

An examination of these figures indicates that although there may be slight variations between the varieties studied, there is a marked seasonal variation in the incidence of smut, the disease reaching its maximum severity (expressed both as number of infected stools and number of infected shoots) during the warmer part of the year. Thus, 45 o/o of the stools of all varieties showed infection in March, while none showed signs of the disease in July and August. It is important to emphasize that the period of lower smut intensity coincides with the dry season which normally extends from June to November.

Table 1 — Incidence of smut on three cane varieties at different seasons (14 holes of each variety) at Pamplemousses Experimental Station (250').

	DK/74 Number of infected		BH 10/12 Number of infected		White Tanna Number of infected		Total Number of infected	
	Stools	Shoots	Stools	Shoots	Stools	Shoots	Stools	Shoots
October /39 ...	1	3	1	1	0	0	2	4
November „ ...	1	2	1	1	4	13	6	16
January /40 ...	4	8	3	5	4	14	11	27
February „ ...	6	14	4	15	6	21	16	45
March „ ...	7	20	5	22	7	39	19	81
April „ ...	6	22	0	0	7	23	13	45
May „ ...	5	11	3	4	4	7	12	22
June „ ...	4	11	0	0	3	6	7	17
July „ ...	0	0	0	0	0	0	0	0
August „ ...	0	0	0	0	0	0	0	0
September „ ...	1	2	0	0	0	0	1	2
October „ ...	1	3	1	1	0	0	2	4
November „ ...	1	6	0	0	0	0	1	6
December „ ...	2	9	4	8	4	13	10	30

Fig. 2 Seasonal incidence of smut in experimental plots at Pamplemousses on the varieties DK/74, BH 10/12, White Tanna. Plain line, number of smutted shoots ; dotted line, number of smutted holes.

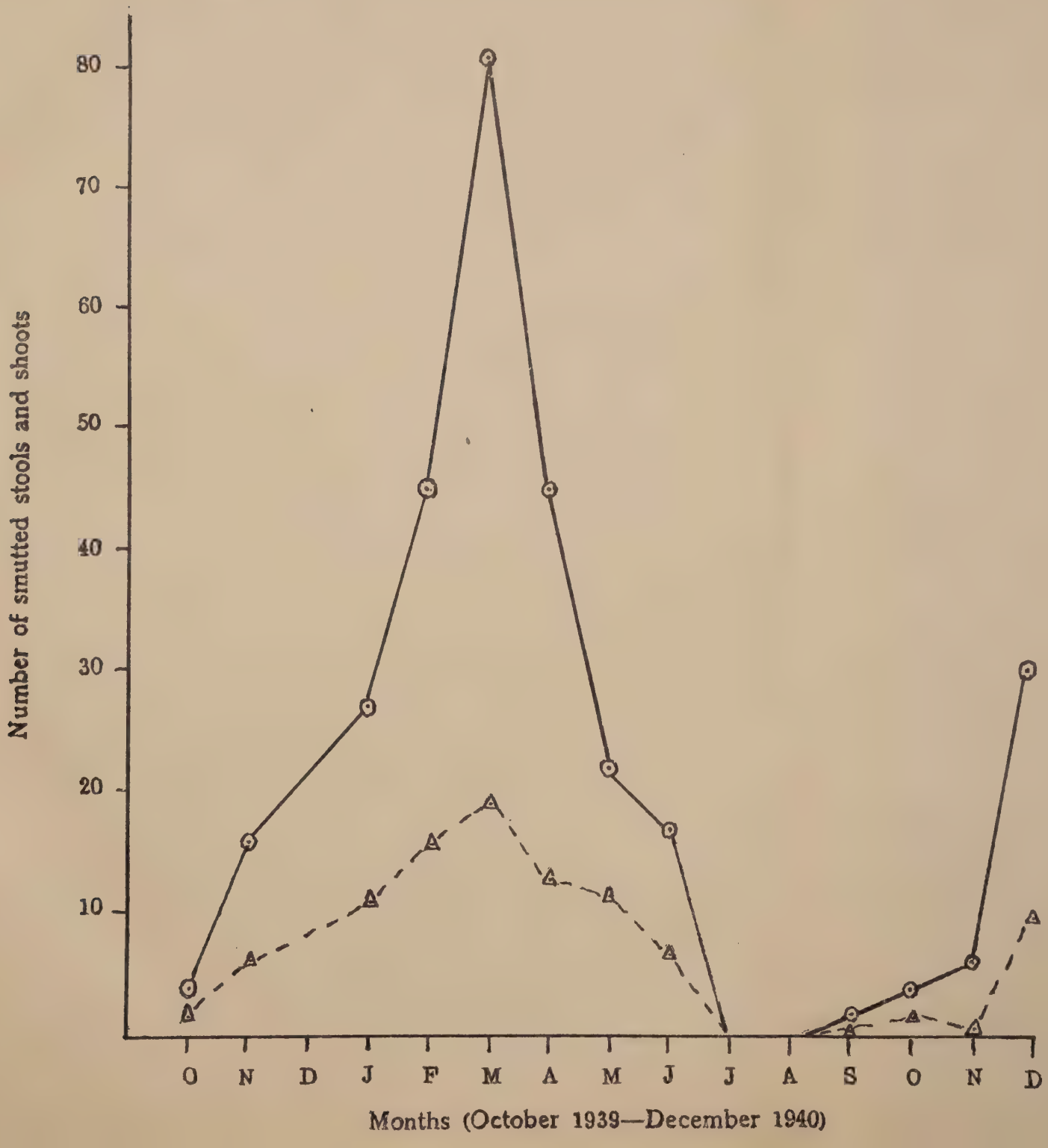


Table 2 — Temperature (°C) and Rainfall (inches) at Pamplemousses during the experimental period.

	October /39	November	December	January /40	February	March	April	May	June	July	August	September	October	November	December
Mean temperature (°C)	21.8	23.6	25.6	25.9	25.7	24.8	24.2	23.2	21.1	20.8	20.7	21.3	22.4	26.1	25.9
Rainfall inches ...	2.39	1.63	12.16	8.23	9.88	9.54	2.26	2.09	2.28	4.23	3.64	1.38	1.68	1.41	2.45

It is a common belief among planters in Mauritius that smut is more prevalent during periods of drought. The results obtained in this experiment, however, demonstrate that of these two environmental factors high temperature, and not lack of moisture, is responsible for causing the appearance of the disease. The data are further confirmed by the fact that smut is prevalent in warm localities where irrigation is practised. The effect of the dissase on the cane plant however is naturally aggravated by drought and under such conditions any stools which might have survived, if affected by one of the factors only, may succumb from the combined action of dry weather and the disease. Such has been the case during the drought years of 1934 and 1939 when whole fields of BH 10/12 had to be replanted in the northern districts on account of the large number of dead stools.

3) *Effect of Planting Material on Smut Incidence*

In order to study the effect of planting material on the incidence of smut in the field, a trial was planted at Labourdonnais S.E. comparing cuttings of the variety BH 10/12 from the estate, where smut was widespread, with cuttings of the same variety from Réduit where the disease is seldom observed.

Sixty plots of 4 holes each were planted in July 1940. Plots with cuttings from a smut-free locality (Réduit) alternating with plots planted with cuttings from a smut locality (Labourdonnais).

The location of diseased stools was recorded at intervals from October 1941 to June 1942, so as to ascertain fresh outbreaks of the disease.

The results obtained are shown in Table 3 and figs. 3 & 4.

Table 3 — Smut infection in plant canes derived from cuttings from a smut-free locality and from a smut locality (120 holes of each).

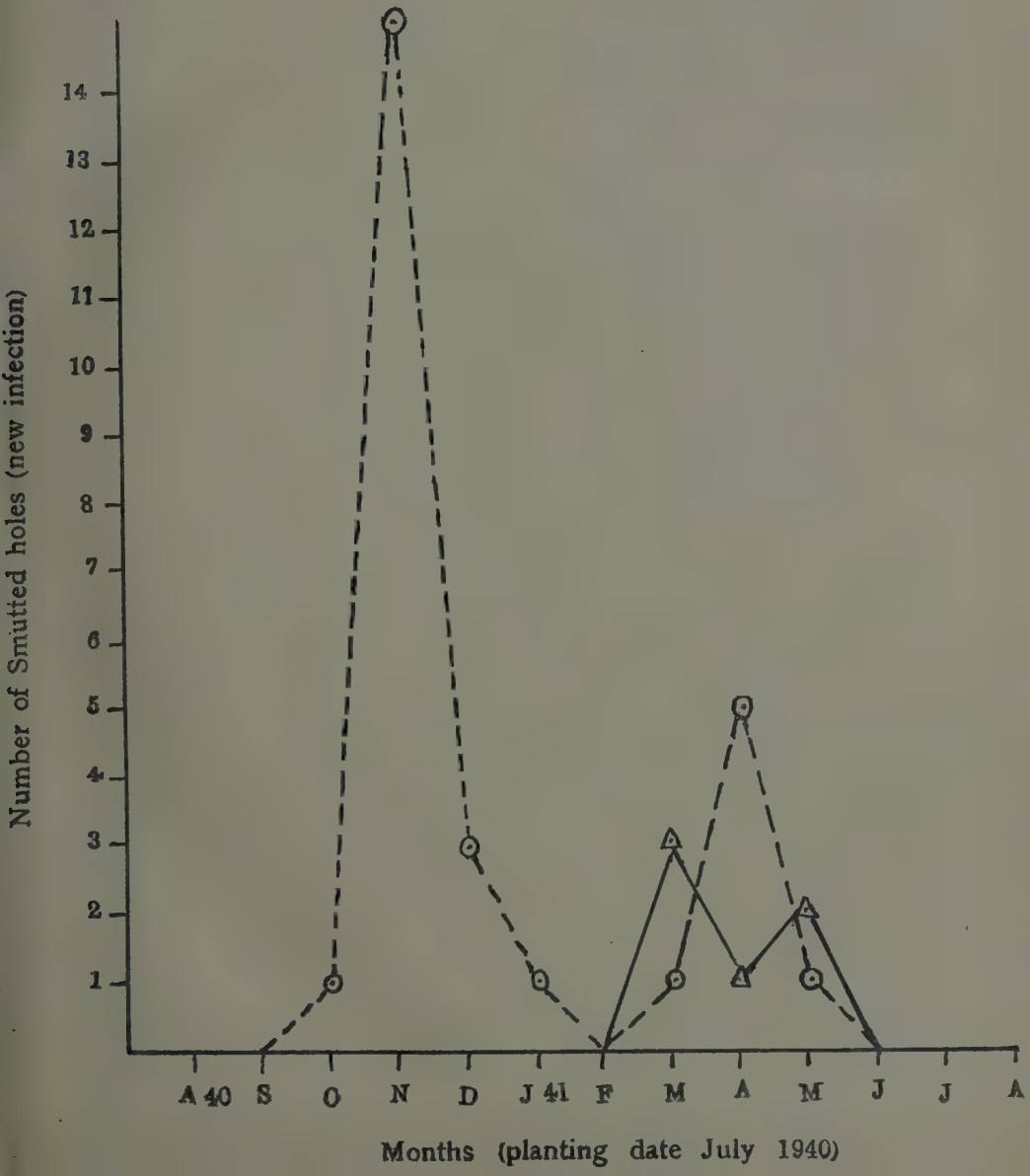
Dates	Number of stool showing infection for the first time	
	Cuttings from a "smut locality" (Labourdonnais)	Cuttings from a "smut-free locality" (Réduit)
October 1941	1	0
November „	15	0
December „	3	0
January 1942	1	0
February „	0	0
March „	1	3
April „	5	1
May „	1	2
June „	0	0
Total	27	6

From the data in Table 3 it may be seen that out of the 120 stools derived from cuttings from a "smut locality", 27 stools or 21.5 o/o, showed symptoms of the disease, while only 6 stools, or 5 o/o, were attacked by smut in the plots planted with cuttings from a "smut-free locality".

These results indicate further that there is a marked difference in the course of incidence of smut after planting according to the origin of the planting material. Thus, two phases can be distinguished: the first with a high percentage of attack from 3 to 6 months after planting and specific to the plots planted with cuttings derived from an infected locality. The second, from 7 to 10 months after planting, showing a smaller incidence of smut and common to both series of plots. Contamination from a diseased to a healthy stool did not appear to have taken place during the first phase of attack as may be seen from the random distribution of smutted holes in fig. 4 in which the position of diseased stools in November and January is recorded.

It should also be pointed out that during the first phase of attack it

Fig. 3 Incidence of smut in plots planted with cuttings from a " smut locality ", dotted lines, and with cuttings from a " smut-free locality ", plain lines.



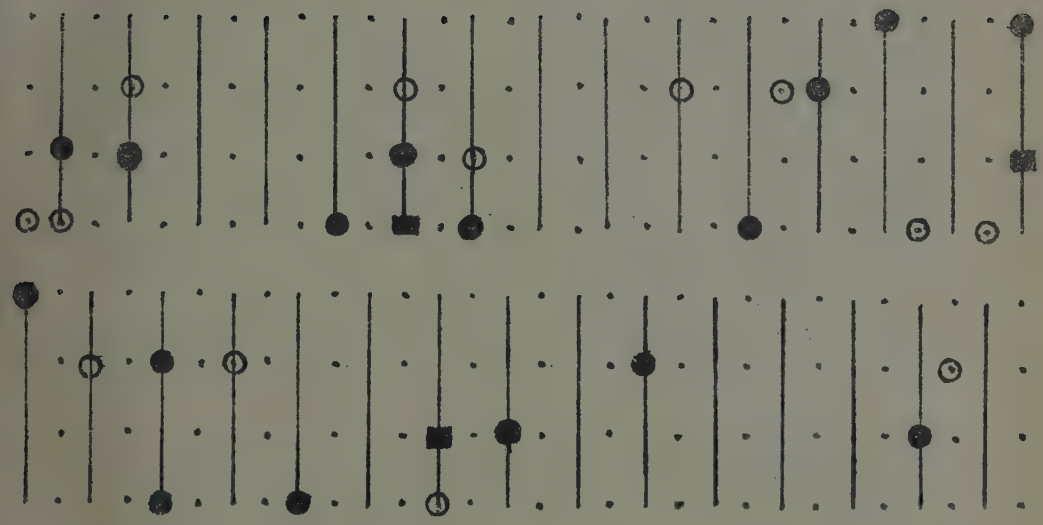


Fig. 4 Incidence of smut in November, black circles ; January, black squares ; February to June, blank circles ; plots planted with cuttings from a " smut locality, " black lines ; from a smut-free locality, dots.

was observed that it was invariably the leading or primary shoots which showed infection, while at a later date the characteristic smutted whips were produced either by the leading shoots or by secondary shoots arising from them.

It is suggested that this difference is due to latent bud infection which would thus appear to be widespread in canes grown in a smut locality and naturally absent from canes grown in localities where the disease is rare. Infection in the second phase probably arises from the air or soil and affects all the stools in the same manner irrespective of their origin.

These views are further supported by the microscopical examination of lateral buds. A cane shoot of normal size (5' long, 1'' diam.) and showing a smutted terminal point was chosen for the purpose (such a form of the disease is not common but may be observed from time to time). All the lateral buds appeared normal externally. Three of these were selected at random and permanent preparations of longitudinal sections were made. These sections showed the presence of inter and intra-cellular hyphæ in the cortical tissue of the buds examined. The presence of the organism in a latent form in the buds is well known in several smut diseases of grasses and although there was no means of ascertaining in this particular case if the hyphæ observed were those of the sugarcane smut fungus, there are reasons to believe that in sugarcane, as in other gramineæ, the life-history of the fungus follows a similar course.

From a practical point of view, therefore, it may be concluded that, with a susceptible cane variety, there is a distinct advantage in importing cuttings from a smut-free locality for planting in a region where climatic conditions are favourable to the development of the disease. Although complete control cannot be obtained by this means, yet the lower incidence of the disease in plant canes will have a beneficial residual effect in ratoon crops.

A BRIEF REVIEW OF THE WORK OF THE MAURITIUS SUGARCANE RESEARCH STATION — 1930-48.

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The Mauritius Sugarcane Research Station was instituted in 1930 with the purpose of applying scientific research on an intensive scale to the problems of sugarcane cultivation in Mauritius. The Station was organized in three main divisions, viz: cane breeding and genetics, chemistry, with special emphasis on soils and fertilizer problems, and botany with special emphasis on sugarcane physiology. Later, an extension service to demonstrate and give instruction in sugarcane cultivation to small planters was added to the Station. For entomological and plant pathological problems close collaboration was maintained with divisions of the Department of Agriculture engaged in research on these problems.

At the time the Station was founded the Sugar Industry of Mauritius was backward in many respects on the field side — the old varieties which had been the backbone of the industry for several decades were giving progressively lower yields; they were unduly sensitive to the vagaries of climate and showed little resistance to various pests which had begun to assume major importance in the Colony, in particular the root-eating larvæ of the beetle Clemora (Phytalus) Smithii.

Although commercial seedling varieties had been produced through uncontrolled crosses at the Department of Agriculture and some of these had attained popularity in restricted areas of the Island, the most urgent requirement continued to be one or more high-yielding commercial varieties to replace the old Tanna varieties and BH 10/12: special types were required for the areas infested with Clemora, for the dry areas of the north and for the poor highly leached soils of the upland districts.

There was at the commencement no established technique of cane breeding suitable for the special conditions of Mauritius. Many related investigations were necessary before a fully satisfactory technique could be worked out.

It was also necessary to carry out special investigations on the isolation of flowering canes for breeding purposes, on the best conditions for the storage of pollen and of fuzz (sugarcane seed), on methods of selection of seedling types, involving sampling technique for canes for sucrose content and the value of the hand refractometer for the determination of sucrose content and on the rapid propagation of selected clones. Prior to the release of promising seedlings, methods had to be worked out for the evaluation of their disease resistance and of their resistance

to Clemora (Phytalus) Smithii. It was desirable also to have information on the physiological basis of resistance to pests and diseases and to drought conditions in order to facilitate breeding for these specialized conditions.

Investigations were also made on the technique of field experimentation with sugarcane in particular on the extent of the border effect and on the most efficient layout for sugarcane field trials. The fertilizer requirements of new varieties were likely to differ from those of the old established varieties and the full value of the new varieties in commercial plantations could not be known until their specific requirements in terms of fertilizer applications and cultural practices and of their time of maturity had been established.

Progress in these directions has been the result of close and active co-operation not only between the divisions of the Station but also between the Station and the divisions of the Department of Agriculture.

In the early years of the Station's activities there was little or no information on the genetics of sugarcane and the demands of the situation were so urgent that breeding methods had to be largely empirical. In other words, the largest number of possible combinations of different varieties were made and the performance of the seedlings obtained was evaluated. Even at the start, it was, however, realized that the introduction of wild blood would be necessary to introduce the resistance required to certain pests and diseases and to contribute extra growth vigour to the new types. The early work of the Station indicated that fourth-nobilized Glaga types were most likely to produce types suitable for Mauritius conditions and this expectation has been substantially strengthened in recent years. Considerable information on the genetics of sugarcane has been accumulated and the breeding programme has largely ceased to be empirical. The total number of possible combinations has been reduced by utilization of only proven crosses together with untried experimental crosses. The technique of selection was greatly improved by adding ratoon selection to the crossing selection.

The identity of parents which transmit resistance to specific diseases has been established and it is becoming evident that suitability to certain climatic conditions is also inherited. Thus, the drought resistance of D 109 has been inherited by its seedling M 134/32. Suitability to the cold wet uplands in the variety M 109/26 was transmitted to its seedling M 73/31, though the latter variety was too susceptible to red rot disease to be propagated on a commercial scale.

Of the first seedlings released by the Station the variety M 171/30 still occupies about 10 o/o of the total island cane acreage. The variety M 134/32 proved to be a most valuable general purpose variety having considerable resistance to Clemora Smithii, high drought resistance, a remarkable capacity of response to fertilizers, good vigour, rapid growth and a satisfactory sucrose content. It now occupies 81 o/o of the island cane acreage. A later release, M 112/34 is suited to a few restricted areas.

The success of the Station's breeding work is confirmed by the fact that over 95 o/o of the canes grown in the Island are seedlings produced at the Station.

The standard set by these varieties has been high as is shown by the fact that the 1947 sugar crop was 348,000 tons and the 1948 crop will not be far removed from 390,000 tons. The weakness of the varietal situation at present lies in over-dependence on the single variety M 134/32. With this mainly in view the varieties M 165/38, M 63/39 and M 76/39 were released in 1945. These varieties have high resistance to red rot disease and remarkable vigour, but are late maturing and sucrose content may be low early in the season. Nevertheless, it is established that they can produce more sucrose per acre than M 134/32 although their late maturing characteristic will preclude a large proportion of the land from being planted in these varieties.

The later varieties M 213/40 and M 423/41 promise to combine the satisfactory vigour of the three above-mentioned varieties with the higher sucrose of M 134/32. It appears probable that these varieties will shortly be released for commercial trials and will undoubtedly constitute valuable alternatives to the varieties at present in cultivation.

The Station has been responsible for a very thorough investigation of the soils of Mauritius ; the physical and chemical properties of samples from the major soil types have been analysed.

All the soils are rich in clay but no relation exists between texture as judged by mechanical analysis and structure in the field, the soils being generally permeable. The degree of laterization as measured by the molecular silica/sesquioxide and silica/alumina ratios is greater the higher the rainfall, the only exceptions being the rocky soils of the wet regions which show a lower degree of laterization than adjacent free soils. Apart from restricted areas of grey soils with generally impeded drainage which differ in some important respects from the typical sugarcane soils, the chief soil types may be classified on the basis of age of the parent rock and the degree of laterization which has occurred. The amount of exchangeable bases left in the soil and the reaction seem to depend on the intensity of the leaching to which the soils have been subjected ; considerable differences have been found in the easily soluble phosphate content in the case of soils from the low and medium rainfall regions. In the highly laterized soils of the wet regions, which are at the same time poor in lime, the easily soluble phosphate is as a rule very low. Soils of the dry districts are potentially rich in potash whereas those of the wet regions are poor in potash. Heavy leaching results in loss of potash, lime, and magnesia. All soils have the property of fixing added phosphate and this property is peculiarly characteristic of lateritic soils. Carelessly cultivated top soils and all subsoils are comparatively poor in total phosphorus and generally contain less than 200 milligrams of total P_2O_5 per 100 grams of dry soil. The surface accumulation of phosphorus in some well culti-

vated top soils (up to 750 mgrs per 100 grams) is artificial and is mainly due to large applications of phosphorus-rich fertilizers and to the continuous restitution of factory residues for many decades. Soil reaction or lime content is an important factor in the availability of phosphate. The approximate relationship between phosphate content and need for phosphatic fertilizer is shown in the following table.

Milligrams P^2O^5 per 100 grams dry soil

Need for phosphate fertilizers	Soil reaction	Total P_2O_5	P_2O_5 soluble in potassium carbonate	Truog soluble P_2O_5
Large	< pH 6.0	< 200 mgrs	< 20 mgrs	< 2.0 mgrs
Moderate & variable	—	200-400 mgrs	20-40 mgrs	2-4 mgrs
Nil (apart from restitution)	—	> 400 mgrs	> 40 mgrs	> 4 mgrs

It has been shown that the sterility of Mauritius subsoils is largely due to phosphate deficiency : phosphate fertilizers and farmyard manure are capable of correcting this sterility. There is thus no directly toxic principle in the subsoil, a theory which was at one time widely held.

The correlation cœfficient between exchangeable bases in Mauritius soils are very high : lime and magnesia + 0.91, lime and potash + 0.87, magnesia and potash + 0.80.

Laboratory experiments showed that the vast majority of Mauritius soils (formed by lateritic alteration) had little or no power to fix potash in a non-exchangeable form, but in the few areas of grey soils formed by clay alteration about a third of the added potash is fixed.

In association with research on soils, an extensive series of fertilizer trials was instituted primarily to test the effects of nitrogen, potash and phosphate at varying rates, alone, and in combination with farmyard manure. In general, these trials showed that virgin or plant canes on the large estates were well fertilized but that ratoons gave a large reponse to nitrogen. Responses to potash and phosphate were localized.

With the advent of new rapidly growing varieties new fertilizer problems arose. These varieties not only made greater demands on the total available mineral elements, but their rapid growth necessitated quickly available supplies. The situation was complicated by shortage of fertilizer during the war, which resulted in partial exhaustion of soil reserves in many localities, particularly of potash and phosphate.

Soil analyses were inadequate to determine the optimum conditions for these varieties and resources were not such that fertilizer trials could be carried out in every field, while large differences in fertilizer status may

occur in fields in close proximity to each other owing to the artificial nature of the fertility which has been built up by restitution of factory residues.

Investigations were accordingly commenced on alternative methods of determination of the fertility status. The possibilites of utilizing the mineral analysis of cane juice and of exudate from cut cane were actively explored before finally adopting leaf analysis as exemplified by the Foliar diagnosis technique of Lagatu and Maume as the most promising method. Full utilization of this method necessitated adequate experimentation on the specific requirements which had to be fulfilled in order that a reliable diagnosis could be effected. The basis of the method is that when the cane plant has reached the stage of rapid growth, corresponding to the steep part of the normal, 'S' curve of plant growth, and when temperature and soil moisture are optimum, the mineral composition of the phisologically active leaves as exemplified by the third leaf from the apex reflets the nutrient status of the plant.

It is necessary, therefore, to take samples when the caneplant has reached a certain stage in its growth (8-10 months in the case of virgin canes, 5-7 months in the case of ratoons) in the period February-April when climatic conditions are favourable for active growth. Discs of green tissue from the leaves sampled are used for analysis. The actual value of nitrogen, potash and phosphate in the leaf dry matter will vary slightly according to the variety.

For the variety M 134/32, whioh now occupies 81 o/o of the area under cane, the composition of the leaf-punch samples for virgin cane should approximate to :—

Nitrogen	...	2.20 o/o
P_2O_5	...	0.50 o/o
K_2O	...	1.60 o/o

The corresponding optima for ratoons are lower. For the early ratoons they approximate to :—

Nitrogen	...	1.85 o/o
P_2O_5	...	0.45 o/o
K_2O	...	1.25 o/o

Experimental data are not yet available for the later ratoons ; the field trials on which the optima are based have only proceeded as far as second ratoons and it is possible that the optima may have to be revised slightly in the case of third to sixth ratoons.

This method has been applied on a commercial scale on an extensive basis with most encouraging results.

Considerable increases in yield have followed the application of fertilizers demonstrated by leaf analysis to be deficient.

Routine analyses have now become the responsibility of the laboratory* equipped by the Sugar Industry Reserve Fund Committee where several thousand leaf samples have been analysed. Some eight hundred samples collected by the extension staff of the Station from the fields of small planters have also been analysed in the current year. The results of these analyses show that much remains to be done before it can be stated that every sugarcane field in Mauritius is receiving its optimum fertilization to produce the maximum yield of sugar per acre. When this state of affairs has been realized there is little doubt that even the record crop of 1948 will be eclipsed in any year when climatic conditions are reasonably favourable.

In the meantime research on the further perfection of foliar diagnosis proceeds in the laboratories of the Station in particular with a view to extending leaf analysis to include elements other than nitrogen, potash and phosphate. It appears probable that the inter-relationship of potash, calcium and magnesium may be of importance, at least in some localities where there may be a deficiency or excess of one or other of these bases. There is also some evidence that micro-element deficiencies or excesses may be present in certain restricted areas. It is hoped to deal with some of these aspects of sugarcane physiology in a succeeding article. In general, however, nitrogen, potash and phosphate are the major elements influencing yields of cane and sugar.

The determination of the optimum fertilizer requirement is only one aspect of the wider field of study on the most efficient cultural methods of sugarcane cultivation which has been undertaken at the Station. The time and method of application of fertilizers is closely associated with the best utilization of available fertilizers. Investigations on these subjects demonstrated that placement of fertilizer only assumed importance in the case of phosphates, which being easily fixed achieve their greatest effect when applied in one dose at, or prior to, planting, at the bottom of the holes or furrows. Localized application within the holes or furrows did not result in further benefit. With respect to nitrogen, potash and farmyard manure, the highest responses were obtained when these fertilizers were applied at planting and the longer the delay in making the applications the lower were the responses obtained. The old practice of "devidage"— or application of fertilizers and manure, chiefly the latter,

* Director, Mr. P. Halais, formerly of the Chemical Division of the Sugarcane Research Station.

in trenches in close proximity to the cane plants — was shown to have no advantages and to have, on the contrary, several disadvantages and the practice has now been generally discontinued.

Investigations were also carried out on such cultural practices as forking, earthing-up, disposal of trash, subsoiling, etc.

The results showed that in general, apart from earthing-up, which produced small increases in yield, the other cultural practices were of little importance and that their effects on yields were small or negligible. Of considerably greater importance is the maintenance of the fields in a weed-free condition. Weed competition is a factor of paramount importance particularly in the unirrigated drier areas of the Island.

In the cultivation of sugarcane, establishment of a full stand of healthy cane plants at the beginning of the cycle is of the greatest importance. Blanks in the fields constitute a factor which may reduce yields per acre over the whole rotation of virgin and ratoon canes. Considerable attention has been given to the requirements of good planting material and to the successful germination and establishment of the cuttings.

There is little doubt that deterioration of varieties in the past has been largely brought about by indifferent selection of planting material and to low percentage germination resulting in weak stools and more or less heavy recruiting.

For many years the technique of sett soaking in saturated lime water helped to produce better stands, but in recent years this practice has been superseded by the use of organo-mercurial disinfectants which not only protect the cuttings from pineapple disease but result in a marked stimulation of early growth resulting in improved yields. In this work the Station played a prominent part, collaborating in the disease aspects with the Plant-Pathology Division of the Department of Agriculture. The influence of the major climatic factors on the growth of the cane crop have been fairly fully investigated. In particular the growth factors affecting drought resistance, and resistance to the pest Clemora Smithii, have been worked out and techniques made available for routine evaluation of the resistance of new varieties to drought and Clemora attack. Contrary to popular belief resistance to Clemora is not due to the mass or density of the root-system, nor to its distribution in the soil, but to the number of reserve root primordia which the cane possesses and to the resulting response in terms of new root formation which follows the stimulus provided by the depredations of the larvae. The potential resistance of a new variety to Clemora attack can thus be determined without recourse to the long and tedious procedure of carrying out resistance trials in heavily infested localities.

Behaviour of varieties under drought conditions may be accurately

gauged by artificially depriving the plants of the roots in the first foot of soil and measuring the growth rate of the stool when it is forced to survive on its deeper roots.

Physiological factors have also been found to be correlated with such pests as borer, and red rot disease. In the case of borer, resistance is closely correlated with high lignin content of the rind and leaf sheaths.

A close correlation has been established between an unidentified phenolic substance in the juice of the cane — probably amino-phenol in nature — which can be estimated by a colorimetric reaction, and the rating of varieties with respect to red rot resistance based on field observations. This method although, at present, purely empirical in nature, may be of great value in identifying susceptible varieties at an early stage.

During the war years unprecedented progress was made in Great Britain and the United States in the development of new chemical selective herbicides and the Station has been active in applying this new knowledge to the eradication of weeds in Mauritius cane fields. The eradication of such noxious weeds as *Hydrocotyle bonariensis* (Herbe Bol), *Ambrosia artemisiifolia*, (Herbe Solferino), *Artemesia vulgaris* (Herbe Chinois) and *Phalaris arundinacea* (Mackaye or Herbe Feu) by chemical herbicides is both practicable and economic, and is being actively carried out on a large number of plantations. General use of herbicides in normal weeding operations has not yet been adopted on a major scale chiefly because of the relatively low labour costs, the high cost of sprayers and the high cost and short supply of some of the chemicals used, particularly for gramineous weeds. Nevertheless much information has been collected and can be applied whenever widespread weeding by means of herbicides can compete successfully with hand labour. It is encouraging to note that planters have become much more weed-conscious in recent years and several thousand acres infested with bad weeds have been effectively cleared. The first commercial weed eradication enterprise started operations in 1948, utilizing the methods recommended by the Station.

Recently the Station undertook to study the value of crushed basalt dust as a fertilizer in the poorer highly-leached soils of the upland districts. Pot experiments with oats and linseed were carried out in addition to a factorial field trial with sugarcane, the latter being a long-term trial which will be followed up for several years.

These investigations have already conclusively shown that the basalt dust exerts its effect in these soils mainly in virtue of its content of available potash. The dust also has a high content of available magnesium, lime and silica, but its small phosphate content is largely unavailable.

In the latter half of 1947 an extension service was incorporated in

the Station. A considerable amount of extension work had already been carried out before this. Over many years chemists from sugar estates were offered facilities for working in the off season in the Station's chemical laboratory under the supervision and guidance of technical staff and the Uba replacement scheme in the Lallmatie and Bon Accueil areas necessitated a considerable amount of extension and propaganda work. Since 1947, however, the Station has had the services of three field demonstrators under the supervision of a Senior Field Demonstrator who had been a member of the Station's staff from its initiation. The number of demonstrators will soon be increased to six. They will be fully engaged on instruction and demonstration work amongst small planters. The raising of production standards for this category of planters will be a valuable contribution to the efficient development of the Island's sugar industry. With this object in view some 800 samples of cane leaf punch samples were taken from small planters fields in the 1948 season and analysed by courtesy of the Director of the Sugar Industry Reserve Fund Laboratory. These analyses, indicating as they do widespread deficiencies of nutrient elements, are of the greatest value in planning the demonstration plots.

Spectacular increases in yields have already been obtained by application of even moderate amounts of the deficient elements in the areas concerned.

The degree of success which the Station has achieved is in no small measure due to the co-operation of the planting community who have placed every facility at the disposal of the Station's technical officers. Many further problems urgently need investigation and it is to be hoped that the Station's staff will once more be brought up to strength so that its work for the Mauritius Sugar Industry may proceed at an ever increasing tempo.

MÉCANISATION ET HUMUS*

par L. DECOUX
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La tendance générale actuelle de l'agriculture est de mécaniser à outrance, à la fois dans les pays à cultures intensive et extensive. Cette mécanisation se justifie presque partout par la cherté de la main-d'œuvre et la résultante négative de l'exploitation du cheval.

Inévitablement, la mécanisation entraîne la suppression graduelle de la cavalerie des domaines. Celle-ci disparaît entièrement dans le cas d'exploitation intégralement mécanisée. La phase subséquente est la réduction, voire la suppression de toute exploitation animale, de telle sorte que le cheptel vivant de la ferme se réduit à zéro. Il s'ensuit un changement complet dans la technique culturale, dont la conséquence inéluctable est la suppression du fumier de ferme, source principale de l'humus.

C'est assez dire que la mécanisation intense de l'agriculture et particulièrement de la production de la betterave, crée de nouveaux problèmes auxquels il est indispensable d'être attentif.

Cette communication a pour but de les examiner.

Qu'est-ce que l'humus ?

Tout d'abord, il est indispensable de rappeler l'origine et le rôle de l'humus dans le sol.

A côté des constituants liquides (eau), gazeux (air, CO^2) et minéraux (argile, sable, calcaire), le sol contient des constituants organiques représentés essentiellement par l'humus.

Nous ne pouvons mieux faire, pour définir ce dernier, que de rappeler ce qu'en dit l'ouvrage récent de L. de Leenheer et G. Waegemans (1) :

" La fraction organique du sol est presqu'exclusivement d'origine végétale. Une faible partie est d'origine animale.

" Bien qu'ayant pris une couleur sombre, souvent même brun-noir, certains restes végétaux conservent plus ou moins la structure des éléments dont ils sont issus ; on peut y reconnaître, même à l'œil nu, des restes de feuilles, racines, brindilles ou autres éléments végétatifs.

(*) Communication présentée au VIIe Congrès International des Industries agricoles, Paris 12-18 Juillet 1948. — Reproduite de " Industries Agricoles et Alimentaires " — Juillet-Septembre, 1948.

(1) De Leenheer L. et Waegemans G. — *La science du sol*, 1948, imprimeur Mereaux, Auderghem Bruxelles, pages 4, 5, 6, 10.

" La plus grande partie (environ les 4/5) de la matière organique qui se forme habituellement dans les sols de nos régions tempérées se compose de produits noirs et adhérents, qui ont perdu le caractère des végétaux dont ils sont issus. Ces produits amorphes et colloïdaux, provenant de l'altération des restes de plantes sous l'action des microorganismes, constituent l'humus.

" On donne souvent à l'expression " humus " un sens plus général, en appelant de ce mot l'ensemble des matériaux organiques qu'on rencontre dans le sol. Cette généralisation est inexacte.

" La teneur en humus d'un sol dépend de la quantité de matières organiques en ordre principal de la quantité de déchets de plantes, qui lui sont incorporés, et de la rapidité avec laquelle ces matériaux sont altérés par les processus d'oxydation et d'humification.

" L'incorporation de substances organiques au sol peut également se faire artificiellement, en particulier par l'emploi d'engrais organiques : fumier, purin, engrais verts, déchets de toutes sortes.

" Les sols des régions tempérées contiennent de 1 à 10 o/o de constituants organiques. Sous les tropiques cette teneur descend souvent en-dessous de 1 o/o, tandis que, dans les tourbières, la matière sèche des sols peut être constituée presque exclusivement de matériaux organiques.

" La matière organique du sol est le siège de ses propriétés biologiques ; il se développe en effet dans l'humus tout une flore et une faune de microorganismes dont les bactéries forment le groupe le plus important.

" L'humus, avec ses microorganismes, fait donc du sol un milieu dynamique vivant, extrêmement favorable à la végétation.

" Il constitue un élément essentiel de la fertilité et de la productivité des terres. Le fumier surtout, les engrais verts ensuite, sont indispensables à l'entretien rationnel de nos terres. Sans humus, les engrais chimiques seraient d'un effet considérablement atténué et il n'est pas sans intérêt de souligner ici le rôle primordial joué par l'application annuelle (culture maraîchère) ou périodique (grande culture) de fumier de ferme.

" Pour mettre en évidence la grande efficacité du fumier, il suffit de comparer la terre de jardin à celle d'un champ sablonneux ou argileux que l'on vient de mettre en culture.

" Dans un sol sablonneux, il n'y a pratiquement (et économiquement) que la matière organique transformée en humus, qui soit capable d'augmenter sensiblement la fertilité de la terre et cela en améliorant à la fois la structure, l'économie en eau et la rétention des matières fertilisantes incorporées par l'agriculteur.

" Du point de vue des propriétés chimiques du sol, l'argile et l'humus sont, du moins dans nos régions tempérées, les constituants les plus actifs ; en outre, comme ces constituants actifs ne coexistent pas à l'état isolé dans la masse du sol, mais se sont mélangés intimement, on les

désigne souvent par l'expression de " complexe argilo-humique " ou " complexe organo-minéral ".

Ajoutons que l'humus joue encore un rôle important quant à la rétention de l'eau et à la germination des graines particulièrement de la graine de betterave.

Avec l'argile, l'humus constitue le complexe adsorbant du sol et fixe à ce titre dans le sol les bases, telles la potasse et l'ammoniaque. Avec l'acide phosphorique, il forme les humo-phosphates éminemment mobiles dans le sol. Ajoutons que la présence ou l'absence d'humus conditionne la structure du sol, sa résistance et son aptitude aux diverses façons culturales. C'est assez dire que l'humus joue dans le sol un rôle à la fois physique, chimique, bactériologique et mécanique.

La teneur des sols en humus.

D'après L. de Leenheer et G. Waegemans, à quantité égale d'humus, l'influence de celui-ci sera plus marquée dans un sol léger que dans un sol lourd. C'est ce qui explique qu'une même expression appliquée à des sols de compacité différente ne sous-entend nullement la présence d'une égale quantité d'humus, comme le montre le Tableau I.

TABLEAU I

La teneur des sols en humus

Appellation	Teneur en humus	
	Sol lourd	Sol léger
Sol pauvre en humus	0 - 2 o/o	0 - 1 o/o
Sol humifère	2 - 5 o/o	1 - 2 o/o
Sol humeux	5 - 10 o/o	2 - 4 o/o
Sol riche en humus	10 - 15 o/o	4 - 8 o/o
Sol tourbeux	+ de 15 o/o	+ de 8 o/o

Dans les sols des régions tempérées, le pourcentage moyen en humus se situe aux environs de 3 o/o.

La détermination de l'humus dans le sol.

Dans le sol les agrologues déterminent le plus souvent la matière organique, l'humus et le rapport C/N.

La matière organique est obtenue par le dosage du carbone total du sol. Sa connaissance présente relativement peu d'intérêt.

L'humus constitue la partie colloïdale de la matière organique. C'est le critère le plus important conditionnant le niveau de fertilité du sol. Il se détermine par exemple par l'extraction à l'oxalate d'ammonium (méthode de CHAMINADE).

Le plus souvent la matière organique est employée pour désigner l'humus, ce qui est de nature à apporter quelque confusion dans le concept de l'humus.

Le rapport C/N varie d'ordinaire entre 10 et 15. Dans ce rapport, on divise la matière organique totale par l'azote total.

Rappelons que C. H. EDELMAN (1), à la suite de recherches nombreuses, a démontré qu'un sol sableux riche en humus à niveau d'eau élevé (1,50 m. dans les Polders hollandais) et perméable est infiniment plus productif qu'un sol argileux, pauvre en humus à niveau d'eau profond (10 m. en Hesbaye) ou présentant un niveau imperméable à faible profondeur.

La teneur de quelques sols betteraviers en humus.

Au cours des années 1933 à 1935, à l'occasion du 1er essai international de Recherches Betteravières (I. I. R. B.), nous avons examiné une série de sols de diverses régions betteravières (2). Il résulte des analyses faites pour une série des sols provenant des pays suivants : Allemagne, Belgique, Danemark, Espagne, France, Hollande, Italie, Pologne, Suède et Tchécoslovaquie que la teneur en humus de ces sols à betterave variait, à cette époque, d'un minimum de 0,74 à un maximum de 3,44 o/o avec les moyennes annuelles suivantes : 1,75 o/o en 1934 et 1,49 o/o en 1935. Ces niveaux sont à considérer comme étant relativement bas.

L'action de l'humus sur la productivité de la betterave.

Alors que l'action de la plupart des facteurs de végétation vis-à-vis de la betterave a été précisée, il a été effectué relativement peu de recherches quant aux relations directes entre l'humus et la betterave.

Le plus fréquemment on s'est borné à étudier l'action respective du fumier de ferme et de l'engrais vert, cela avec une série de modalités, concluant le plus souvent à l'action fertilisante supérieure de l'engrais vert par rapport au fumier de ferme (3).

Mais nos observations ont concordé pour affirmer que si l'engrais vert a une efficacité plus grande sur la betterave à sucre que le fumier de ferme, par contre son action se continue moins favorablement sur les

(1) EDELMAN C. H.— *La classification et l'estimation de la valeur des terrains agricoles aux Pays-Bas et aux Indes Néerlandaises,*— C. R. Ac. Agr. Fr., 1948, No. 8, p. 636.

(2) L. DECOUX, J. VANDERWAEREN et M. SIMON — *Conclusions du premier essai international organisé par l'I. I. R. B.* — Publ. Inst. Belge Amél. Bett., 1936, No. 4, p. 122.

(3) L. DECOUX — *Dix années de recherches à l'Institut Belge pour l'Amélioration de la Betterave de* 1932 *à* 1941, p. 123, 127.

autres récoltes qui suivent la betterave sucrière. Au surplus, si l'action immédiate de l'engrais vert est plus grande que celle du fumier de ferme, il est vraisemblable que son influence sur la teneur en humus du sol est plus faible. Ajoutons que l'engrais vert a encore l'avantage d'un pouvoir de sorption plus grand que celui du fumier de ferme (pouvoir de fixation des bases Ca, Na, Am, K, Mg).

Les sources d'humus.

En dehors du fumier de ferme il est possible, dans nos régions tempérées, de reconstituer l'humus dans le sol en faisant appel à des sources diverses d'engrais organiques. Le Tableau II donne quelques exemples comparés aux engrais verts et au fumier de ferme (d'après DUNOD) (1).

TABLEAU II

Composition centésimale % de divers engrais organiques

	Azote organ.	P^2O^5	K^2O
	—	—	—
Gadoue de la Ville de Paris ...	0,45	0,17	0,55
Déchets de laine	5 à 10	—	—
Vinasse de distillerie de mélasse...	0,20	0,10	0,50
Vinasse de distillerie de betterave	0,1 à 0,2	0,05	0,1 à 0,2
Engrais verts			
A — Résidus par ha et en kg laissés par			
- Luzerne de 3 ans	205 kgs.	45 kgs.	66 kgs.
- Trèfle de un an	121 kgs.	18 kgs.	23 kgs.
- Sainfoin de trois ans	127 kgs.	28 kgs.	42 kgs.
B — Luzerne	0,72	0,16	0,45
Vesces	0,56	0,13	0,43
Féverolles	0,44	0,06	0,42
Pois	0,55	0,11	0,50
Trèfle incarnat	0,43	0,08	0,20
Collets de betterave à sucre ...	0,20	0,12	0,28
Fumier de ferme			
Chevaux	0,58	0,28	0,53
Bêtes bovines	0,34	0,16	0,40
Fumier mixte demi-décomposé ...	0,50	0,26	0,53

Les chiffres du Tableau II montrent la richesse particulièrement élevée des déchets de laine en azote organique. Le plus souvent on en applique 2.500 kgs à l'ha pour la betterave à sucre, ce qui constitue, au

(1) *Aide-Mémoire Dunod, Agriculture*, p. 84, 56.

départ, un apport de 2.500 × 5/100 = 125 kgs d'azote organique, alors que 30 tonnes de fumier demi-décomposé en fournit 150 kgs. Une autre différence existe entre ces deux engrais organiques quant à leur vitesse d'action, à considérer rapide pour les déchets de laine et lente pour le fumier de ferme.

D'autres comparaisons peuvent encore être faites. Mais la réflexion la plus importante à formuler est que l'on ne connaît guère la répercussion précise de ces divers engrais organiques sur la teneur en humus du sol.

Nous avons systématiquement écarté du Tableau II certains engrais organiques qui portent, à des titres divers, le nom d'engrais humiques.

D'après M. LENGLEN (1), ces engrais dits humiques accusent un prix de vente excessif ; ils révèlent, en outre, une fraude fréquente.

L'évolution de l'humus dans le sol pendant la guerre et l'après-guerre.

La guerre 1939-1945 a agi sur le sol en diminuant notamment sa teneur en chaux et en humus. Au surplus, les circonstances industrielles et économiques, qui ont suivi la libération ont eu comme conséquence subséquente d'accroître l'appauvrissement du sol en chaux et en humus. Actuellement encore le manque d'aliments concentrés pour le bétail conduit à la formation de fumier de ferme pauvre.

C'est assez dire que l'apport de fumier de ferme au sol a diminué en quantité et en qualité, ce qui a eu pour résultante une diminution générale du niveau de fertilité. En fin de guerre, chez divers céréaliculteurs ayant fortement diminué l'exploitation du bétail, on a pu enregistrer du grain de mauvaise qualité, ainsi qu'un échaudage fréquent, conséquences du manque d'humus dans le sol. Ailleurs, certaines céréales se refusent à produire les rendements élevés accusés antérieurement.

Il faut encore ajouter que la manutention du fumier de ferme étant de toute manière désagréable et très coûteuse on a cherché à en diminuer la dépense et les ennuis.

Un dernier facteur est apparu, en grande culture surtout, pour diminuer la production de fumier de ferme. Il faut citer la mécanisation. Graduellement le planteur qui se mécanise réduit sa cavalerie, puis pense à supprimer les autres exploitations animales. La tentation est grande et il en résulte une simplification énorme des soucis de l'agriculteur.

Que devient le sol privé de fumier de ferme ? Il s'appauvrit en humus. Tout d'abord la carence en humus ne se marque guère, le sol étant supposé bien approvisionné. Mais après 20 à 30 ans de ce régime, le sol s'appauvrit en humus et acquiert une structure de plus en plus défavorable. Sa productivité va diminuant.

Du point de vue économique, ces transformations se traduisent d'a-

(1) LENGLEN M. — *Les fraudes en matière d'engrais et d'amendements.* C. R. Ac. Agr. Fr., 1948, No. 8, p. 629.

bord par une diminution appréciable du prix de revient des récoltes. Mais, par la suite, le rendement des récoltes tombe à un niveau tellement bas que le contraire se produit. Au surplus, la valeur du capital " terre " diminue. Il y a accroissement de la rente, au détriment de la valeur vénale du sol. Il va de soi que la suppression ou la réduction d'apport de fumier de ferme dégradera le sol de manière différente suivant la teneur originale du sol en humus. C'est ainsi que des sols jeunes riches en humus (alluvion, schorren) pourront supporter une exploitation sans fumier pendant une longue période, comme c'est le cas dans les polders récents hollandais. Le mal constaté n'est pas sans remède. Mais la régénération d'un sol dégradé est lente et coûteuse.

Comment parer au déficit d'humus?

Le mal étant détecté, il s'agit d'y parer. Comment? On pense tout d'abord à un changement de rotation dans laquelle on veille à des apports fréquents de matières organiques. C'est ainsi que les pratiques suivantes pourront pallier à la carence d'humus : la culture de plantes légumineuses, telles la luzerne, le pois, le haricot, la féverole ; la pratique intensive des engrais verts, notamment dans et après le lin ; l'escourgeon et l'orge de printemps, le pois ; la création de prairies temporaires remplaçant les prairies permanentes ; l'enfouissement du vert de betterave au lieu de sa vente directe ou indirecte, sous forme de rémunération de main-d'œuvre. De toute manière, au cours d'une rotation de quatre années, par exemple, il apparaît nécessaire qu'il y ait au moins une fois une plantation de légumineuses et une année d'engrais verts.

Ces différentes techniques ne sont pas sans défaut. L'établissement de luzernières, de trèflières, de prairies temporaires constitue une source d'infection du sol par le taupin. Au surplus, les dépenses de graines qu'elles supposent constituent un handicap à leur adoption. Il faut encore mentionner l'aspect le plus important de leur culture, à savoir l'aspect économique, ces cultures n'étant possibles que si elles sont rentables.

En France, dans les régions où la grande culture se pratique sans ou avec peu de bétail, et dès lors avec peu de fumier de ferme, on a adopté la rotation suivante : luzerne pendant 2 ans, betterave, blé, betterave, blé. Cette technique existe depuis longtemps. Elle a le grand avantage de comprendre la luzerne pendant le quart de la rotation. Or la luzerne est la plante de grande culture la plus favorable au point de vue pédologique, en même temps qu'elle assure la plus grande production végétale.

Aux engrais verts, on reproche le danger de salissement des terres avec en outre le défaut d'un matériel organique facilement et rapidement décomposable. Leur succès dépend de l'importance des précipitations après la récolte des cultures principales. Pour les engrais verts de printemps, si la climature estivale est humide, comme en 1948, il y a danger que l'engrais vert ne nuise fortement au développement de la plante abri. De toute manière, les engrais verts enrichissent le sol en azote. Nos essais

ont démontré qu'une récolte normale d'engrais verts apporte au sol un enrichissement en azote équivalent à 75 kgs N. Mais à l'encontre du fumier de ferme, les engrais verts n'apportent au sol ni la potasse, ni l'acide phosphorique, ni le sodium contenu dans le fumier de ferme. Ils ont cependant l'avantage de déplacer ces éléments fertilisants du sous-sol vers le sol.

En vue de reconstituer l'humus dans le sol, il n'est pas interdit de penser à des cultures fourragères intercalaires, telles le seigle, l'orge, le ray-grass ; la moutarde à enfouir jeune et à renouveler 2 ou 3 fois après l'enlèvement de la culture principale. Mais on ne connaîtra rien de précis à ce sujet sans des essais préalables.

Nous avons systématiquement écarté le fumier artificiel dont le coût est trop élevé.

A Rothamsted, on a obtenu des résultats favorables avec la paille appliquée à l'automne en vue de la culture de la pomme de terre. Vis-à-vis d'autres cultures, cette technique s'est avérée néfaste.

On pourrait encore préconiser l'épandage après la moisson de la paille découpée, cela en liaison avec l'usage de la moissonneuse-batteuse, dont la fermentation serait favorisée par une application d'engrais ammoniacaux ou amidiques et dont l'enfouissement serait superficiel.

En fin d'année, l'enfouissement de paille serait encore à envisager, en prévoyant, l'année suivante, une application supplémentaire de quelque 200 kgs d'engrais azotés, afin de faire face à la dénitrification occasionnée par la fermentation de la paille.

La mise au point de ces diverses techniques appelle des études préalables.

Dans cet ordre d'idées, nous avons antérieurement étudié les mélanges maïs et légumineuses, ainsi que seigle et légumineuses. Ces solutions ont accusé une valeur inférieure à celle des légumineuses seules.

La réduction des frais occasionnés par le fumier de ferme.

Avant que de passer à ces solutions nouvelles, il apparaît plus sage de chercher à réduire les frais occasionnés par le fumier de ferme.

Une première solution consiste à utiliser le plus possible dans les étables le court-bâti. Ce dernier permet la suppression de la paille, toutes les déjections étant centralisées dans la fosse à purin. Celle-ci est vidée aussi souvent qu'il est nécessaire. Cette méthode du lisier est expérimentée depuis peu dans quelques régions herbagères de Belgique (Lens-sur-Dendre, Froidchappelle). Seule l'expérimentation permettra d'en juger la valeur.

Une deuxième solution consisterait à épandre la paille sur les terres sur lesquelles le bétail serait maintenu tout ou partie de l'hiver.

Une troisième solution consiste à maintenir le bétail sur des fumières, celles ci présentant un enclos de construction simple, avec des auges amo-

vibles le long des parois. Ce système permet la mise en œuvre d'une quantité importante de paille et dispense du transport du fumier de ferme de l'étable à la fumière.

Une quatrième solution est appliquée à la ferme de Säbyholm de la S. S. A. en Suède. Elle consiste à déverser le fumier directement dans les chariots et remorques et à le voiturer dans les champs sans passer par la fumière. Afin de réduire la main-d'œuvre, un chemin en fosse, à plans inclinés est établi parallèlement aux étables dans lequel les chariots et remorques reçoivent le fumier à chaque vidange des étables. Ce procédé est possible à l'automne et en hiver, du moins pour les champs ne portant pas de culture. Mais au printemps et en été, force est de constituer des tas de fumier en bordure des champs où des déperditions sont inévitables. A nouveau des essais montreront la valeur de ce fumier frais comparé à du fumier fait.

Avec le procédé habituel d'entassement du fumier dans la fumière, on peut réduire les frais de manutention en faisant appel aux appareils suivants : le transport du fumier à la fumière au moyen de traîneau à chaîne ou bien avec des wagonnets disposés sur un rail aérien — le chargement du fumier avec une pelle mécanique placée à l'avant du tracteur — l'épandage du fumier avec un épandeur de fumier (1).

Nous rappelons, pour mémoire, les méthodes à suivre pour améliorer la qualité du fumier de ferme et augmenter son taux de transformation en humus (2).

Il est indéniable qu'après l'enlèvement des récoltes de céréales les éteules constituent une source appréciable d'humus. Avec l'emploi des moissonneuses-batteuses, fauchant à un niveau élevé du sol, l'importance de cette source d'humus ira croissante. Mais il serait paradoxal que l'usage des moissonneuses-batteuses conduisit à la vente des pailles. Si la moissonneuse-batteuse était suivie d'une ramasseuse-déchiqueteuse de fourrage, la paille récupérée pourrait être répartie en menus morceaux sur le terrain et faire l'objet d'une fertilisation organique, comme nous l'avons décrit plus haut.

Quelques cas extrêmes présentés par l'humus.

Aux Etats-Unis, depuis l'époque héroïque des premiers pionniers agriculteurs remontant à 50 - 100 ans, le sol a été le plus souvent exploité de manière extensive (3) sans aucune restitution d'humus. Il en est résulté une dégradation telle du sol, que le soleil aidant, la couche arable a été enlevée par le vent, créant une érosion telle que la culture y est devenue impossible, cela sur des milliers d'ha de superficie.

(1) L. DECOUX — *La mécanisation de la culture de la betterave. Les expériences des deux dernières campagnes.* Sucrerie Belge 1er et 15 Juin 1948.

(2) L. DECOUX — *Dix années de recherches à l'Institut Belge pour l'Amélioration de la Betterave de* 1932 à 1941, p. 125.

(3) L. DECOUX — *La production de la betterave sucrière aux Etats-Unis au lendemain de la guerre.* Publ. Inst. Belge Amél. Bet., 1946, p. 49.

Un phénomène semblable s'est produit, mais suivant une mesure bien plus forte, dans les pays chauds, où le soleil tropical, combiné avec les pluies diluviennes des saisons humides, ont rendu le sol stérile, le plus souvent après des déboisements intempestifs.

On explique, de la même manière, l'origine de nombreux déserts, tels le Sahara, la Mésopotamie, etc.

En Belgique, dans la région du Veurne-Ambacht, il y a des terres qualifiées de " blekgrond " — D'après M. R. TAVERNIER, le terme de " blekgrond " a une double signification. Il y a lieu de distinguer le " Zandblek " et le " Kleiblek ". Dans les Polders, c'est le " kleiblek " qu'on connaît. Celui-ci résulte de la destruction de la structure du sol dû au manque d'humus. On le rencontre surtout dans les *terrains lourds* et spécialement dans les prairies transformées en champs de culture. Après peu de temps, l'humus de la végétation herbagère disparaît et la structure s'effondre complètement au point de transformer la couche arable en une argile compacte. Le remède est simple : augmenter la teneur en matières organiques.

Mais à l'opposé de ces cas malheureux, il est des régions de culture très intensive, où des agriculteurs n'ayant que peu ou pas de bétail mettent la fourniture de fumier de ferme au sol au premier plan de leurs préoccupations. C'est le cas de maraîchers et horticulteurs qui consacrent chaque année des capitaux énormes à l'achat de fumier de ferme. Ils savent que ce dernier porte la fertilité du sol à un plafond très élevé, accroît sa précocité et permet, en dernière analyse, 3 à 4 récoltes échelonnées de légumes, alors qu'en grande culture on s'estime satisfait si le sol produit une récolte essentielle et une culture intercalaire ou dérobée.

Enquête au sujet de l'humus.

Après avoir consacré au sol betteravier belge une série de travaux, nous pensons qu'il est opportun d'organiser une vaste enquête quant à sa teneur en humus.

Nous sommes persuadés qu'il existe des sols belges à betterave très pauvres en humus. Nous sommes tout autant certains que des planteurs cherchent à réduire le prix de revient de la betterave en réduisant l'incidence du fumier de ferme et en accroissant l'intervention des engrais verts. Nous rappelons aussi le nouveau point de vue des planteurs se dirigeant vers une mécanisation totale, l'exploitation devenant un centre de production végétale, abandonnant toute production animale.

Il nous est difficile de concevoir des essais permanents dans lesquels le sol serait d'une part, fertilisé au fumier de ferme — d'autre part privé de fumier de ferme — pendant une longue période de 25 à 50 ans. Des

résultats ne seraient acquis que bien tardivement. Souhaitons néanmoins que l'Institut de la Betterave devienne bientôt propriétaire de quelques ares de terrain, sur lesquels des essais semblables et beaucoup d'autres seraient possibles.

Mais une enquête analytique immédiate sera vraisemblablement la source de constations originales.

1. — Tout d'abord, il y aura intérêt de procéder à un examen des régions où le fumier de ferme est méconnu, si pas inconnu depuis une longue période de temps, mais où cependant le rendement de la betterave se maintient à un niveau élevé. Nous pensons à la Thudinie, les Polders du Veurne-Ambacht, du Hazegras — les îles hollandaises de Tholen, Duiveland — la région de Groningen — les départements français de la Somme, de l'Aisne. Une documentation devra être réunie afin de préciser comment l'humus est restitué au sol de ces régions.

2. — Ensuite, dans la région de la Hesbaye, rechercher les caractères du sol quant à l'humus, pour des exploitations ayant respectivement beaucoup, peu, plus de bétail — pour des domaines accusant des rendements extrêmes de betterave soit élevés ou faibles.

L'extension de l'étude du sol.

Le souci grandissant de connaître de mieux en mieux le substratum sur lequel se développe la betterave sucrière porte de plus en plus loin la nécessité d'étudier les différents facteurs conditionnant sa fertilité.

Jusqu'à présent, la plupart des laboratoires de terre ont déterminé les besoins en éléments fertilisants des sols à betterave, y compris le pH et le besoin en chaux. Il apparaît de plus en plus nécessaire d'adjoindre à ces déterminations celle du niveau de la nappe phréatique, ainsi que la teneur en humus et des examens de profil. Cet ensemble de déterminations nouvelles ne devra affecter que quelques sondages pour une région déterminée.

Leur aboutissement sera la mise au point de cartes de classification des sols, succédant à un premier stade de cartes pédologiques. C'est bien le but que poursuit depuis l'an dernier, dans les polders de Furnes, le Centrum voor Bodemkartering de l'Université de Gand dirigé par M. R. Tavernier.

Les cartes de classification des sols aboutissent à préciser la valeur d'une région déterminée vis-à-vis d'un type de culture déterminée, par exemple les cultures arables (y compris la betterave,) les cultures sous verre, les cultures maraîchères, les vergers, etc. Leur mise au point appelle la collaboration d'experts, spécialistes dans telle ou telle culture déterminée.

L'examen microbiologique d'un sol présente moins d'importance, la vie microbienne d'un sol déterminé étant sous la dépendance de sa teneur en humus et de sa teneur en oxygène laquelle dépend en grande partie de sa structure et de sa composition physique.

Il est vraisemblable que des recherches semblables pratiquées en dehors des régions betteravières feront découvrir de nouvelles régions aptes à la culture de la betterave. Tant il est vrai, par exemple, qu'un sol léger, humeux, à niveau élevé de l'eau de la nappe aquifère présentera plus de possibilités de culture de la betterave qu'un sol compact pauvre en humus, exposé à la sécheresse par suite d'un niveau trop bas de la nappe phréatique. C'est assez dire que d'une stérilité complète à une fertilité élevée il y a une longue transition, dans laquelle se situent des sols de propriétés physiques très différentes, auxquelles une fertilisation à la fois organique et minérale permet, grâce à une balance d'eau favorable d'assurer une production satisfaisante.

Au sujet de la méthode de préparation superficielle du sol au printemps, liée avec la précocité du semis de la betterave (1), nous ferons remarquer que seul un bon état physique général permet vraisemblablement l'exécution de cette méthode. Celle-ci sous-entend, en effet, une teneur convenable en humus, d'où découle une structure favorable à une réduction des façons culturales, soit un sol vivant et non inerte.

Recherches supplémentaires.

Cette étude conduit encore aux réflexions suivantes.

1.— Alors que la sélection s'est attachée d'une manière générale, à perfectionner les plantes de grande culture, il paraît opportun de suggérer aux spécialistes la nécessité de la sélection des engrais verts, tels la vesce, le pois fourrager, au sujet desquels des essais antérieurs ont fait apparaître des différences appréciables suivant leur origine.

2.— On peut encore penser à l'utilité d'une sélection de la betterave réalisée dans des conditions physiques défavorables de sol tel un sol carencé en eau.

L'année 1947 a montré dans nos pays le désastre que peut occasionner une sécheresse extrême. Ailleurs, un régime pluviométrique pauvre en précipitation limite d'ordinaire la productivité de la betterave. Sans penser à une betterave xérophile, il est des régions betteravières qui trouveraient un avantage appréciable à utiliser une variété de betterave résistante à la sécheresse, ainsi qu'aux maladies diverses que celle-ci occasionne ou favorise, telles la jaunisse, la cercosporiose, etc.

(1) DECOUX L. — *La méthode de préparation superficielle du sol.* Publ. Inst. Belge Amél. Bett 1948, No. 3.

3.— Une structure favorable du sol ainsi qu'une teneur suffisante en humus constituent des facteurs favorables à son ressuiement au printemps et au semis précoce. Il nous est difficile de concevoir l'existence de terres dites froides au sommet de collines (Warnant-Dreye) où le semis précoce est difficilement réalisable, sans penser à une dégradation du sol découlant d'une carence en humus.

4.— Des centres de recherches phytotechniques trouveraient un programme important d'activité dans le problème général de l'humus quant à sa constitution et à son maintien.

Les spécialistes en mécanique devront apporter leur concours à l'effet de diminuer la quote-part énorme que revêt le coût de la manipulation du fumier de ferme dans le prix de revient de la betterave.

Enfin, les économistes seront appelés à déterminer les méthodes les plus opportunes pour élever le taux du sol en humus.

CONCLUSIONS

L'extension graduelle de la mécanisation porte l'attention sur le dilemme suivant : le fumier de ferme est-il oui ou non indispensable à la culture de la betterave ?

La réponse provisoire peut être que le fermier de ferme, considéré comme tel, n'est pas indispensable. Mais la betterave, comme toutes les autres plantes de la grande culture, demande un sol ayant une teneur suffisante en humus. En l'absence de fumier de ferme, l'humus sera le mieux assuré au sol par la pratique de culture intercalaire d'engrais vert ; l'introduction dans la rotation comme plantes principales de légumineuses ; l'adoption de luzernières, tréflières, etc. Nous ne pouvons préjuger de l'intérêt économique de ce changement de plan de culture.

Notre intention essentielle a été d'abord de montrer un danger, ensuite de développer les moyens de le conjurer en maintenant la fécondité de la culture de la betterave, dans le cadre actuel d'évolution de l'agriculture.

MAURITIUS ECONOMIC COMMISSION 1947-48

THE REPORT OF COMMITTEE No. 6

Sugar Industry Finance

The greater part of the Report of the Finance Committee is devoted to the ascertainment of fact. This proved more difficult and is of more importance than might appear. For example, the words sale prices, profit, capital, and cost of production, to give a few as examples, have always been recognised to be subject to a variety of possible interpretations — dependent sometimes on the context or purposes of the desired assessment, sometimes on the nature of business concerned and sometimes on differing schools of thought.

From the standpoint of Colonial administration and the particular type of problems which have arisen and may be expected to arise in the case of Mauritius, it has already been shown to be of prime importance that all concerned, both in London and Mauritius, should understand the same things by the same words. There is real value, therefore, in having arrived at agreement not only of the measure of sale prices, production costs and net profits for the past few years, but also in having laid down the lines on which such assessments should be made for the future.

The essential figures for recent years have been as follows—

Crop year	Effective sale price of sugar f.o.b	Estates' net profits	
	Rs. per ton	Millions of Rupees	Rs. per ton
	Rs. c.		
1939	151.33	— 0.1	— 0.60
1940	169.17	+ 7.1	+ 22.46
1941	169.32	+ 6.0	+ 18·43
1942	196.80	+ 9.1	+ 27.68
1943	196.72	+ 6.5	+ 21.21
1944	255.24	— 3.4	— 16.99
1945	362.20	— 4.9	— 35.85
1946	288.84	+ 6.5	+ 22.42
1947 (estimated)	336.18	+ 24.7	+ 66.65

If similar methods of computation and analysis are adopted for the future, it should be possible to identify and measure all sources of change. Time did not permit of further analyses being prepared both of the pro-

duction and overhead costs. This work should be developped later. The clerical personnel made available to the Commission sufficed for only the more important analysis.

It is to be observed that profits have been ascertainable only for the estates, which, taken together, own all the factories, manufacture all the sugar and grow about half the cane. Having regard to the dominating and crucial position which the sugar industry occupies in the economy of Mauritius, it is surprising how sparse are the available quantitative data relating to the industry and how much delay is involved in obtaining additional information, at least on the financial side.

This deficiency in the statistical services was referred to in the report of a local commission of enquiry in 1943 and, in accordance with their recommendation, Government established a Statistical Bureau in 1945. Whilst this Bureau has undoubtedly gone part of the way towards filling some of the gaps in the Island's statistical service in the economic and social fields, it has been insufficiently endowed both with skilled personnel and legal powers to attempt any analysis of the financial side of the sugar industry. On the other hand, the Chamber of Agriculture, which is an unofficial association of the factory owners and larger planters, has made some efforts since 1943 to establish a routine for the collection and tabulation of trading results of the estates. In this connection, they have also sponsored the adoption by estates of a uniform system of cost accountancy which is now adding considerably to the potential value of the financial data which are collected. Little progress has been made so far in putting to practical use the material which is collected but it was made freely available to the Commission's Finance Committee and was of considerable value to the Committee in framing its report.

All members of the working party were agreed on the necessity for collecting financial and statistical data relating to cane planters as well as for improving and extending the regular collection, scrutiny, tabulation and, to some extent, publication of similiar data in respect of all branches of the sugar industry. There is, however, no agreement on the way in which this should be done. The Finance Committee recommends that the Chamber of Agriculture should develop the foundation it has already laid in this field and that Government should be given access to the results of such researches and to any original data it might need for purposes of checking the results. On the other hand, the representatives of labour and small planters in the Working Party, as well as the overseas members, consider that the Chamber of Agriculture laudable as its objects are cannot be regarded as the impartial body on which Government could be expected to be dependent for the information which it needs and should need.

Centralisation of the collection of financial information by Govern-

ment relating to the leading industry of the Colony is recommended not on theoretical or academic grounds nor even only to secure economy — which would undoubtedly be realised, but because it has been shown in practice to be essential to eliminate overlapping of activity on the one hand and gaps on the other which result from the collection of such information being undertaken by several bodies.

At present, at least seven Departments or agencies of Government are responsible for collecting financial information pertaining to one or more aspects of the sugar industry, namely—

Statistical Bureau ;
Department of Agriculture ;
Department of Labour ;
Central Arbitration Board ;
Agricultural Bank ;
Cyclone and Drought Insurance Board ;
Price Stabilisation Fund Board.

In certain cases—notably that of the Central Arbitration Board, as is repeatedly stressed by the Finance Committee—the proper performance of their functions is seriously impeded by the lack of adequate machinery for the collection and scrutiny of financial data. More generally, as many members of the working party have found, lack of such data acts as a serious limitation to any attempts, which are clearly now called for, at comprehensive planning of the island's whole economy. It was suggested to the Committee that the scope of the central office could be extented to take over the entire accounting of the industry, including the preparation of the annual accounts, but there is reason to believe that the majority of the estates are not in favour of such a change at present.

As regards the sale price of sugar, the Committee noted that the higher customs duty on raw sugar polarising in excess of 99°, as compared with sugars polarising between 98° and 99°, was at present paid by the Ministry of Food. The Finance Committee agreed with Committee No. 9 that this customs penalty on raw sugars exceeding 99° polarisation should be abolished in respect of all sugars certified as delivered to a *bona fide* refiner in the United Kingdom. The Committee also considered that the extra price for 99° sugar as compared with 96° sugar which has remained constant at 6¾d per cwt. should be increased *pro rata* with the increase in price of sugar. Although the Ministry of Food buys Mauritius sugar on a c.i.f. basis, the Ministry agreed from the beginning to accept responsibility for the whole cost of freight over the pre-war rate of 24/9d per cwt. The re-casting of the Colonial Sugar preference certificates in 1934 proved disadvantageous to Mauritius. The point of equilibrium at which the new system is equivalent to the old system is when Mauritius exports total

233,000 tons. When this figure is exceeded, as has frequently been the case, the new tariff is disadvantageous.

Estates' expenditure is accounted for by the main headings : cost of planters' cane, labour, other production expenditure, depreciation, charges of town agents, selling and distribution expenses, interests, cyclone and drought insurance and the central reserve funds of the industry.

The cost of planters' cane is controlled by an organisation known as the Central Board, the duties of which are described in the report. It is considered that the functioning of the Board would be improved by the appointment of a professional lawyer trained in the weighing of evidence and the hearing of cases before Court. The Committee was also of the opinion that a right of appeal to the Supreme Court should be allowed. The Central Board is guided in determining the payment due to planters by a basis rate of two-thirds of the sugar extracted from each ton of cane supplied. Special circumstances, however, may justify a departure from this principle and it rests with the Central Board to give more than, or less than, two-thirds whenever circumstances justify a departure from the enunciated principle. In order to aid the Board to arrive at a fair decision, the Finance Committee considered that it is a matter of urgent necessity that a qualified accountant be attached to the Board and that he should undertake to provide up-to-date cost of production data. An attempt should also be made to devise some system or formula which would operate with greater precision and leave less need for the exercise of discretion by the Board in individual cases.

As a constituent item in the estates' total expenditure, the cost of labour directly employed by the estates has risen from 18 per cent. in 1938 to 32 per cent. in 1946 and this is mostly a reflection of increases in wage rates over that period mainly to meet rises in the cost of living. These percentages do not include a large element of labour costs involved in the purchase price of planters' canes. The cost of bagging has risen from Rs. 4.00 per ton of sugar in 1938 to Rs. 15.50 in 1947.

Apart from arriving at agreement on the amount of net profits of the major branch of the sugar industry, the Finance Committee also attempted to estimate the proportions in which these net profits were derived from cane growing on the one hand and sugar manufacture on the other. This could only be an estimate because there are no recognised commercial prices at which growers are regarded as selling their cane to millers. However, the assumption on which these estimates are based is described in detail in the Finance Committee's report as is also the statutory formula governing the determination of prices to be received for cane by growers who do not own a factory.

The final net profits in rupees for the years 1938, 1942 and 1946 were as follows—

	1938	1942	1946
	Rs.	Rs.	Rs.
From estates' cane cultivation ...	1,613,557	5,057,731	2,013,918
From manufacture :			
(*a*) Estates' cane	2,373,812	5,055,095	5,242,624
(*b*) Planters' cane	2,257,438	3,928,639	3,024,012
TOTAL ...	6,244,807	14,041,465	10,280,554

Although the necessity for amalgamation of factories into larger units (integration) or the replacement of a group of small factories by one new large one (centralisation) is brought out clearly in the report which shows that the production costs of the small factories (making under 7,000 tons of sugar per annum each) are consistently 30 per cent. above those of the larger factories making over 10,000 tons of sugar each, the Finance Committee concluded that integration of the manufacturing side of the industry would be both unnecessary and inadvisable as there are insufficient data to assess the financial implications of any such scheme.

In addition to analysing the composition of trading results for the greater part of the sugar industry, the Finance Committee attempted also to appraise the present and prospective capital position of the industry and again, owing to limitation of records, concentrated mainly on the factory-estates, all of which are owned by incorporated companies or registered partnerships. An analysis of the accounts of these companies and partnerships showed that the investment in factory estates, as at the end of the 1946 crop, was recorded as Rs. 92 million and that the capital for this investment had been provided as to Rs. 52 million by the equity proprietors and Rs. 40 million in the form of long-term borrowing—usually on mortgage security. It is this high proportion of loan capital to equity capital which has fostered the impression in many quarters that the sugar industry is " burdened with debt " in the sense that it is in a parlous state. The report of the Finance Committee should have the effect of finally laying this fallacy and will be of particular value on that account. The fact is, of course, that for half a century at least and probably longer it has been customary for estates to be purchased with a high proportion of borrowed capital and, unless owners are able and willing to introduce additional capital of their own in lean years, they naturally find it difficult or impossible to carry on for any length of time if losses are incurred or profits are insufficient to meet both the owners' need for dividends and the provision which should be made for renewal and replacement of depreciating assets such as plant and machinery, rolling stock and buildings. The sugar industry of Mauritius (using that expression as a collective term to embrace the individual proprietors) must expect, like any other enterprise, to have a due proportion of bad as well as good years and should be capitalised on a scale which recognises that. In addition, full advantage

should be taken of prosperous times to strengthen the industry to weather poor years which may be expected to follow.

Another aspect of the subject of capitalisation investigated by the Finance Committee was that of fixed asset values. As stated above, the amount recorded in the companies' and partnerships' books as invested in the factory estates is Rs. 92 million and of this amount about Rs. 83 million are fixed assets the remainning Rs. 9 million representing the excess of current assets over current liabilities. The Mauritius Companies' Act of 1912 provides that the basis of valuation of fixed assets shall be described in all company balance sheets but as this requirement of the law is disregarded more often than not and the books of most estates' companies do not show the necessary details, it is impossible to give an analysis of the recorded value of fixed assets.

The practice of most estates in Mauritius has been to charge as revenue expenditure most of the cost of renewal and replacement of plant machinery and rolling stock and to make no provision in the accounts for a depreciation fund. The assumption has, therefore, been made that on the average the recorded value of fixed assets represents original cost and that depreciation not provided has been balanced by capital expenditure charged to revenue. It has also been possible to have access to a professional physical inventory of the plant and equipment of all estates including an estimate of written down values.

After weighing these various considerations, it has been estimated that Rs. 80.5 million of the fixed assets are employed in the production of sugar and comprise—

Land	Rs. 44.5 million
Factory equipment, buildings and rolling stock	36.0 „
	Rs. 80.5 „

It is pointed out by the Finance Committee that these fixed assets have been acquired by their owners at different times and at different price levels over perhaps the past 50 years and the Committee estimates that a fair long-term value to put on these assets to-day would be—

Land	Rs. 59 million
Factory equipment, buildings and rolling stock	74 „
	Rs. 133 „

Extensive factory re-equipment is needed to secure economy in sugar manufacture. The Finance Committe considered that Rs. 40 million for the next five years would be sufficient to provided for this. It is not thought necessary to raise new capital by means of a public issue for this purpose. Half the sum would be found as follows—

Loan from Colonial Development and Welfare Fund ...	Rs.	6 million
Rehabilitation Fund (allocations from four crops 1946 to 1949)		14 „
	Rs.	20 „

It is considered that the remaining half should be available from profits over the next few years.

Another important subject to which the Finance Committee devoted its attention was that of the financial organisation of the industry. The Committee's conclusions were that the present practice should be continued and that development and improvement should be left to the free play of individual enterprise.

Thus, the Committee considered that so long as individual producers require their services, the functions of brokers as *bailleurs de fonds* should continue unchanged.

The Committee was opposed to any scheme for compensating high cost producers at the expense of low cost producers. The formation of a capital equalization or compensation fund to facilitate and accelerate any process of reorganization and rationalisation of the industry and to compensate high cost producers who would thereby be eliminated was also not favoured.

Summary of Principal Recommendations

1. It is essential to improve the standard and increase the scope of the collection of statistics and financial data of the sugar industry. A new central office should be established for this purpose. The porposed central office could usefully undertake to collect much of the data at present collected by Government Departments. In order to ensure uniformity of statistics and financial summaries, all estates should conform to the same accounting year which should be the calendar year.

2. The price margin between 96° and 99° polarisation sugar should be increased by about 8¼d per cwt. in order to maintain the pre-war rates.

3. The Committee has recommended that the United Kingdom customs penalty on sugar exceeding 99° polarisation, at present paid by the Ministry of Food, should be abolished in respect of all sugar delivered to a United Kingdom refiner, if and when the Ministry ceases to accept this liability.

4. The Committee recommends that when the present Ministry of

Food c.i.f. arrangement ceases, the Mauritius Sugar Syndicate should advertise for freight tenders, both in Mauritius and elsewhere, instead of inviting tenders as is done at present, and should seek competitive quotations for marine risks insurance.

5. Interest on temporary advances by the Mauritius Banks to the Sugar Syndicate should carry a rate of interest far below the present rate of 5 per cent. in view of the security offered.

6. The following changes should be made in the administration of the Central Board which governs the relations of planters and millers—

(*a*) a professional lawyer should be attached to the Board in the capacity of assessor ;

(*b*) a right of appeal to the Supreme Court should be allowed from the decisions of the Board ;

(*c*) safeguards should be devised against undue delays and excessive cost in connection with appeals.

7. The basis of assessing the price to be paid for planters' cane should continue to be related to the sucrose content of the cane and the sale price of sugar, but, as soon as adequate data are available, the Central Board should study the equity of the present method of allocating the cost of cane transport in calculating the price to be paid to planters for their cane.

8. To apply the necessary flexibility to the present board formula for determining a fair price to be paid for planters' cane, the Central Board should be in possession of up-to-date cost of production figures. It is, therefore, a matter of urgent necessity that a chartered accountant should be appointed to the Board at an adequate remuneration and the contribution made by the sugar industry to the Board should be increased to meet whatever might be the cost of the necessary accountancy service.

9. An improved formula in place of the present basis of determining the price of planters' cane is necessary. Subject to further investigation and to consultation with the interests affected, the following basis is provisionally commended : the award to cane growers of all the profit after deduction of—

(*a*) manufacturing and distribution expenses ;

(*b*) a fixed rate of interest on the capital invested in factories.

10. All estates should adopt the practice of providing for depreciation (only about 20 per cent. at present do so)—the basis of depreciation calculation already recommended to the estates by the Chamber of Agriculture is approved.

11. A central agency for the purchase of all supplies for estates should result in economy: such an agency should materialise through the initiative of the producers.

12. The brokerage charges should be reduced by 6 per cent.

13. The duty of 20 cents per ton on exported sugar should be

abolished. In general, it is recommended that such duties on gross sales should not be imposed.

14. The present provision for the calculation of the Cyclone and Drought Insurance Fund premium is too complicated and needs simplification. Administration of the Fund could probably be done more economically by the Agricultural Bank.

15. The Rehabilitation Fund represents a policy of forced saving which should be discontinued after the arrears of factory rehabilitation have been disposed of, should the Ministry of Food cease to make specific provision in the sugar price for payments thereto.

16. The raiding of the Price Stabilization Fund to pay cyclone and drought insurance premiums should be continued only until factory re-equipment is completed.

17. On the grounds of economy of operation, there is considerable scope for amalgamation of small factories.

18. The Agricultural Bank should be empowered to raise further capital in order to help to retard an expected increase in the rate of borrowing. It should also be empowered to make long term loans to enterprises other than agriculture.

19. A minority of the Committee recommended that legislation concerning the activities in which the Agricultural Bank may engage should be modified to allow the Bank to undertake crop financing. In this connection, a minority consider that the intervention of brokers in their capacity as *bailleurs de fonds* in assisting crop financing should be discontinued.

20. The Agricultural Bank's rate of interest to borrowers could be reduced if its own capital were permanent and not repayable by instalment to Government by whom it is provided.

21. The Bank should be empowered to make long-term loans in suitable cases which would not be repayable by regular annual instalments.

22. Extensive factory re-equipment is needed to secure economy in sugar manufacture. This should be achieved gradually, the objective being the fulfilment of a planned scheme of integration and centralization. It is not considered necessary for this purpose to raise new capital by means of a public issue.

COMMENTS ON THE REPORT OF COMMITTEE No. 6

Sugar Industry Finance

The limitations of the data which could be made available to the Committee investigating Sugar Industry Finance are symptomatic of the inadequate organization of the financial side of the industry. Recent progress has been made in estates accounting as a result of the initiative

shown by the Chamber of Agriculture to which the island owes a considerable debt. Considerable improvement is, however, still possible in extending the regular collection, scrutiny, tabulation and to some extent publication of data. The collection of financial and statistical data relating to cane planters is an urgent necessity. It is to be remarked that the financial data of the estates for 1947 are still not available in June 1948. This situation would be entirely different were there established a Central Office responsible for the entire accounting of the whole industry including the preparation of the annual accounts. The Central Office would have to be equipped with modern equipment and should employ a highly trained chartered accountant.

In spite of the conclusions of the majority of the members of the Finance Committee, some members of the Commission are of opinion that the Mauritius Agricultural Bank would be the most suitable institution to undertake responsibility for assembling and collecting as a matter of routine the information needed on the financial aspects of all branches of the sugar industry. The Chairman of the Bank is appointed by the Secretary of State and the Bank enjoys the standing, impartiality, independence, discretion and, it is believed, respect of a Government institution without being directly a branch of Government. The Bank's administration has been shown to be economical and efficient. If an Economic Counsellor were appointed to Mauritius—as is recommended elsewhere—he might suitably be associated with the administration of the Bank.

Considerable place has been given both in the Sugar Industry Finance Report and in the Sugar Marketing Report to the United Kingdom penalties on sugar exceeding 99° polarisation which is at present borne by the Ministry of Food. It is, however, to be expected that the United Kingdom authorities may have views on the results of any change in the customs tariffs on the future position of the Colonial producers. Granted that it is not desirable for Mauritius to manufacture 96° sugar owing to the risk of deterioration during storage and transport, it may still be possible to manufacture sugars of higher polarization which would not be subject to a customs penalty.

The overdraft interest rate of 5 per cent. which the Mauritius Sugar Syndicate pays to the banks is too high in view of the security offered and the same rate of interest (5 per cent.) charged by the Syndicate on advances made out of undistributed proceeds is also too high.

With respect to the relations between the planters and the millers and the price to be paid for planters' cane, there is little doubt that, in view of the relative risk involved, the millers' proportion of the earnings of the industry is too high. In the opinion of some members of the Commission, the lesson to be learned from these sections of the report is that millers occupy a dominating position in the industry out of proportion to the

function which they perform. The production of sugar, at least in the circumstances to be found in Mauritius, is primarily an agricultural operation. It is the growers who carry most of the risks and who should receive most of the profits. In fact, it is found that millers retain a substantial profit not only in good years but in bad years as well when the whole loss (or more than the net loss) falls on the growers. Under present conditions, the greater part of the cost of processing or conversion of cane into saleable sugar is outside the control of millers and sugar manufacture can be scarcely described as a free economic enterprise of itself. It is in reality a technical service to an agricultural enterprise and as such, justice would be best served if cane growers in general had a greater financial interest in the factories in Mauritius. Although the main producing interests of Mauritius are not at present ready to see the picture of the industry in that light, it is to be hoped, on social as well as economic grounds, that they may come to do so in due course. In the meantime, it cannot be admitted that there is much merit in their objection that the technical efficiency of sugar factories must inevitably deteriorate under such a system ; the character and skill of management does not change with some change of ownership, neither need incentive be less.

As regards implementation, it should not prove difficult, through the medium of the co-operative movement or by other means, so to group the smaller cane growers as to facilitate the institution of a simple financial method to be operated by the Agricultural Bank whereby cane growers collectively could share to some extent in the ownership of factories. It would not, however, be desirable for a partnership group of such growers to own one or more individual factories because this would constitute a serious impediment to the progressive reduction in number and increase in size of factories, which is a movement which should be accelerated not retarded in Mauritius.

Since progressive organization within the industry has not yet advanced to the stage that would make such an achievement acceptable, a re-organization of the Central Board is desirable. It would be of the greatest benefit to all interests if the re-organization of the Central Board were part of the duties of an Economic Counsellor whose activities would be concerned with the administration of the Agricultural Bank in its expanded spheres of action. A professional lawyer and a chartered accountant should also be attached to the Board in the capacity of assessors. The disproportionate share of revenue paid to the millers is responsible for the fact that labour considers that it is not having its full share of the earnings of the sugar industry. Whereas labour costs represent approximately 66 per cent. of the cost of cane cultivation (the actual figure for estates is 68 per cent.), labour costs as a percentage of the total expenditure of the sugar industry are estimated to be 51 to 53 per cent. The discrepancy in the figures of labour costs as an item in the total cost of manufacture, which is given as 44 per cent. in para. 74 (c) of the Report and the figure of

12.8 per cent. given in para. 144, is stated to be due to the fact that the latter figure does not include the labour items in factory supplies and in maintenance. Nevertheless, the figure of 44 per cent. given appears to need further investigation. Although the investigations of the Committee clearly demonstrated that the cost of production of sugar by the larger factories in some 30 per cent. lower than that of the small factories, the Committee was not prepared to agree for example that any scheme should be formulated for closer economical association of producers for the purpose of facilitating and accelerating—

(*a*) the elimination of the small factories which are relatively so uneconomic ;

(*b*) the erection of more modern factories ;

(*c*) the release of a certain proportion of the Island's leaders (most of whom are at present monopolised by the sugar industry) to assist in implementing some of the Commission's many recommendations for broadening the base of Mauritius economy and reducing the Island's virtual dependence on one product ;

(*d*) the re-arrangement of the manufacturing side of the industry so as to give all cane growers an interest in the milling function.

Neither was the Committee in favour of initiating any concerted plan to improve the system of financial organization of sugar production and marketing which is at present in the control of some 20 factors known as brokers or *bailleurs de fonds*. The report makes it clear that the brokers at one time performed three functions one of which, the selling of sugar, is now wholly undertaken by the Sugar Syndicate and the second of which, namely acting as Port Louis agents for certain of the larger producers, could in fact be more economically performed by a central agency. It is the opinion of some members of the Commission, therefore, that the time has come for the routine obligatory payment to brokers of a fixed commission on the whole net value of all sugar produced to be discontinued. As a first step, the $\frac{3}{4}$ per cent. commission paid by the Sugar Syndicate could be stopped and, if necessary the constitution of the present Syndicate amended accordingly. All producers, including small planters, should then be free to send their sugar direct to the Sugar Syndicate for disposal and, as the Syndicate is not a profit making institution, no commission would be payable. Those producers who still wish to engage the services of a broker as town agent could then make whatever voluntary arrangements for remuneration they wished and there is no reason why they could not be based on a percentage of turnover.

The third conventional function of brokers, namely acting as *baillsurs de fonds* or channels for crop financing, is a definite operation separately

remunerated over and above normal brokerage. In fact, these services are furnished for only 400 or so of the larger producers, and 15,000 odd small cultivators obtain their working capital mostly from the estates to whom they sell their cane, or from co-operative credit societies. It is not apparent that cane or other crop cultivation in Mauritius is such a risky undertaking that cultivators of any size should not be able to obtain the temporary accommodation they need direct from the banks as agriculturists do in other countries. The elimination of brokers from this financing process would not add much to the amount which the banks were called on to lend and if their risks were increased in certain cases they could cover that in the same way as brokers do at present but probably at less cost. It is to be noted that, when a broker relends money borrowed from a bank, he charges not only a higher rate of interest, but also an additional commission on the borrower's total crop.

In this connection, some members of the Commission consider that it would be advantageous for the constitution and capital of the Agricultural Bank to be enlarged so that they may be empowered and enabled to provide crop finance. The Finance Committee advised against this development although its report confirms that the Bank has clearly succeeded in establishing intimate contact with cultivators and this is of the very essence of sound crop financing.

With reference to the valuation of equipment, some members of the Commission have found it impossible to accept a valuation for equipment equivalent to no less than its original cost, having in mind particularly—

(*a*) the technical report given to them that no replacements of any consequence have been effected for at least 20 years. The age of the greater part of the equipment is amply described in the report of Committee No. 7 ;

(*b*) that it is necessary now to spend at least Rs. 40 million to put the factory equipment in a reasonable state of efficiency.

It may be, if that Rs 40 million is spent to best advantage, with regard only to the future economy of the industry as a whole, that the resulting value of the equipment would be in the neighbourhood of Rs. 74 million, but it is difficult to defend a present valuation which anticipates future expenditure.

On the third aspect of capitalisation of the sugar industry, it is a matter of common agreement that, notwithstanding the very high level of technical ingenuity and resourcefulness of the managerial personnel, most of the factory equipment is in a very run down state and some members of the Commission consider that the Finance Committee displays an undue optimism as to the high proportion of the cost of re-equipment which can be

met from projects without recourse to the introduction of much fresh capital. It is true that for 1946 and 1947 both the crops and the sugar sale price have been exceptionally good and it is more or less certain that 1948 will be no worse. There are, however, certain important features which must not be overlooked—

(*a*) the world commercial situation in relation to sugar is likely to deteriorate as soon as the war-devastated areas resume full production ;

(*b*) in Mauritius, it must be expected that organized labour will succeed in making out a case for appreciably higher remuneration—having regard to the large projects now being made by most estates ;

(*c*) as there are no safeguards against part of the re-equipment expenditure being devoted to factories which have no future, it is probable that the estimate of Rs. 40 million for re-equipment expenditure will prove to be too low ;

(*d*) the plan as presented makes no proper provision for meeting the cost of the Cyclone and Drought Insurance Fund as the assumption is made that the contributions to this fund, which should properly fall as a normal charge against profits, will continue to to be met, as they have been for the past two years, from the resources of the Price Stabilization Fund. This is an improvident policy.

A word is necessary about the Cyclone and Drought Insurance Fund itself. This is a most valuable innovation having regard to the very heavy losses which have in past years been experienced from those causes and which must be expected to occur again at intervals. It is, therefore, important for the stability of the economy of Mauritius that the fund should not be dissipated in the payment of compensation for relatively small regional losses or alternatively that the scale of premiums and the operation of the fund should be actuarially investigated with a view to instituting the modifications necessary to provide against a breakdown of the fund in the event of a major calamity.

The practice of meeting the cost of the Cyclone and Drought insurance fund from the Price Stabilization Fund cannot be said to be a provident policy and the latter fund should be used to fulfil the purpose for which it was intended, viz., stabilization of prices as soon as circumstances permit. Neither will the interests of the industry as a whole be served by the practice of utilizing the Rehabilitation Fund to provide funds for the re-equipment of factories in an indiscriminate way and irrespective of whether the particular factory has a future in the economic organization of the industry. The decision of the Committee investigating Sugar Indus-

try Finance to recommend that, should the Ministry of Food cease to buy Mauritius Sugar or cease to make provision in the price for payments to the Rehabilitation Fund, this policy of forced saving should be discontinued, does not seem to be wise in view of the failure of the industry to make provision for rehabilitation plans prior to the establishment of this Fund. While it is true that in the past 25 years the industry has experienced a more than reasonable proportion of poor years and that trading results have been so modest that the weaker estates have suffered embarrasment and some have not survived, all the indications are, however, that there was ample opportunity in the years of unprecedented boom and phenomenal profits following the first world war to make adequate financial provision for the poorer years which followed and that in the case of many estates that opportunity was lost. It is to be hoped that that experience will not be forgotten now that large profits are once again being enjoyed by most producers.

It appears from the investigations of the Sugar Industry Finance Committee that the majority of estates make a practice of running on too fine a margin of permanent subscribed capital to be able to weather bad years and the additional capital which they have needed at those times has up to now been provided usually not by Government but through Government by the public. Nobody has lost anything by it because—with certain minor postponements—the borrowers have honoured all their repayment obligations. This has not been an onerous custom for producers. It avoids the subscription of capital which may not be wholly needed in good years and permits of the enjoyment of a higher percentage yield on proprietors' capital—so long as the rate of interest on borrowed capital is not excessive. The Committee did not advise on the use to which the Labour Welfare Fund should be put. It would seem, however, that the Fund would be most usefully employed partly to reduce the margin between rates of wages in the intercrop season and those in the crushing season by supplementing wages in the intercrop season and partly to aid in the establishment of a pension fund for monthly employed labourers.

STATISTIQUES

1°. CLIMATOLOGIE

(a) Pluviométrie (Pouces)

Localités / Mois	Nord				Centre					
	Pamplemousses Gardens	Pamplemousses (Normale)	Abercrombie	Abercrombie (Normale)	Beau Bois (Moka)	P.W.E.S.	Réduit	Réduit (Normale)	Curepipe	Curepipe (Normale)
Nov. 1948	1.86	2.13	3.60	2.12	4.31	2.74	1.89	2.33	6.62	5.71
Déc. „	3.27	4.91	2.78	4.66	6.12	8.70	3.10	6.37	9.27	9.71

Localités / Mois	Est				Ouest					Sud		
	Centre de Flacq	Camp de Masque	Palmar	G.R.S.E.	Port-Louis	Case Noyale	Beau-Bassin	Beau-Bassin (Normale)	Richelieu	Rose Belle	Camp Diable	Chemin Grenier
Nov. 1948	6.30	4.79	4.28	5.12	4.25	2.94	1.57	2.31	2.21	9.97	5.11	3.46
Déc. „	2.60	7.53	1.74	2 31	1.82	4.49	0.94	5.78	1.65	14.36	7.27	3.46

(b) Température °C

Localités	Beau-Bassin		Réduit				Curepipe		Richelieu	
Mois	Max.	Min.	Max.	Min.	Moy.	Nor.	Max.	Min.	Max.	Min.
Nov. 1948	25.1	18.8	26.7	17.7	21.8	2.18	24.4	17.8	28.6	20.4
Déc. „	26.0	2.07	27.4	20.0	23.3	23.4	25.0	18.8	29.4	22.8

(c) Insolation

Réduit		
Mois	Heures de soleil	Fraction d'insolation
Nov. 1948	257.40	66.0 %
Déc. „	251.07	61.1 %

2° Sugar Crops of the World

WILLETT & GRAY'S CROP ESTIMATES

September 30th 1948

(1) CANE SUGAR

	Harvesting Period	METRIC TONS 1948-49	1947-48
United States—Louisiana	Oct.-Jan.	335,296	269,373
Florida	Dec.-April	86,364	71,668
Puerto Rico	Jan.-June	1,016,050	1,005,247
Hawaiian Islands	Jan.-Dec.	863,642	780,326
Virgin Islands	Jan.-June	5,080	5,080
Cuba	Jan.-June	5,435,867	6,055,429
British West Indies—Trinidad	Jan.-June	121,926	117,805
Barbados	Jan.-June	76,204	58,686
Jamaica	Jan.-June	230,948	195,948
Antigua	Feb.-July	20,321	20,321
St. Kitts	Feb.-Aug.	28,449	20,321
Other B.W.I.	Jan.-June	8,636	9,348
French West Indies—			
Martinique	Jan.-July	40,642	45,722
Gaudeloupe	Jan.-July	35,562	40,642
Dominican Republic	Jan.-July	431,821	421,634
Haiti	Dec.-June	45,722	48,770
Mexico	Dec.-June	635,031	609,630
Central America—			
Guatemala	Jan.-June	68,075	72,140
Salvador	Nov.-Mar.	24,385	25,298
Other Central America	Jan.-June	37,594	32,514
South America—Demerara	Oct.-June	182,889	170,809
Colombia	Oct.-June	81,284	96,525
Surinam	Oct.-Jan.	7,112	10,161
Venezuela	Oct.-June	32,514	34,749
Ecuador	June-Jan.	33,530	30,482
Peru	Jan.-Dec.	421,661	447,062
Argentine	June-Oct.	599,470	615,744
Brazil	June-May	1,422,470	1,331,026
Total America		12,328,545	12,642,460
India and Pakistan (Gur)	Dec.-May	3,860,990	3,759,385
" " (White)	Oct.-July	1,524,075	1,320,865
Java	May-Nov.	101,605	81,284
Japanese Empire	Nov.-June	30,482	50,803
Taiwan (Fromosa)	Nov.-June	457,223	267,515
Philippine Islands	Nov.-June	655,352	362,730
Total Asia		6,629,727	5,842,582
Australia	June-Nov.	838,241	611,764
Fiji Islands	June-Nov.	130,054	142,247
Total Australia and Polynesia		968,295	754,011
Egypt	Jan-June	203,210	224,547
Mauritius	July-Dec.	365,778	356,859
Réunion	July-Dec.	86,364	86,364
Natal and Zululand	May-April	508,025	464,484
Mozambique	May-Dec.	76,204	84,332
Angola	May-Oct.	50,802	50,802
Total Africa		1,290,383	1,267,388
Europe—Spain	Dec.-June	17,273	16,257
Total Cane Sugar Crops		**21,234,226**	**20,522,697**

Sugar Crops of the World

(Continued)

(2) BEET SUGAR

	Harvesting Period	Metric Tons	
		1948-49	1947-48
Europe—Germany	Sept.-Jan.	1,117,655	784,391
Czechoslovakia	Sept.-Jan.	660,433	355,618
Hungary	Sept.-Jan.	203,210	159,520
France	Sept.-Jan.	863,643	660,433
Belgium	Sept.-Jan.	254,013	139,200
Holland	Sept.-Jan.	254,013	224,306
Russia and Ukraine	Sept.-Jan.	3,048,150	2,743,335
Poland	Sept.-Jan.	558,828	518,186
Sweden	Sept.-Dec.	279,414	243,852
Denmark	Sept.-Jan.	254,013	213,371
Italy	Aug.-Oct.	279,414	218,451
Spain	July.-Feb.	203,210	119,894
Switzerland	Sept.-Jan.	24,385	21,693
Bulgaria	Sept.-Jan.	60,963	20,321
Roumania	Sept.-Jan.	101,605	73,156
Great Britain*	Sept.-Jan.	508,025	436,048
Eire*	Sept.-Jan.	81,284	60,963
Jugoslavia	Sept.-Jan.	91,445	81,284
Turkey	Sept.-Jan.	111,766	98,186
Other countries	Sept.-Jan.	117,862	83,316
Total Europe		9,073,331	7,255,524
United States—Beet*	July-Jan.	1,331,026	1,597,113
Canada—Beet*	Oct.-Dec.	81,284	71,070
Total Beet Sugar Crops		**10,485,641**	**8,923,707**
Grand Total—Cane and Beet		**31,719,864**	**29,446,405**

* Refined Sugar